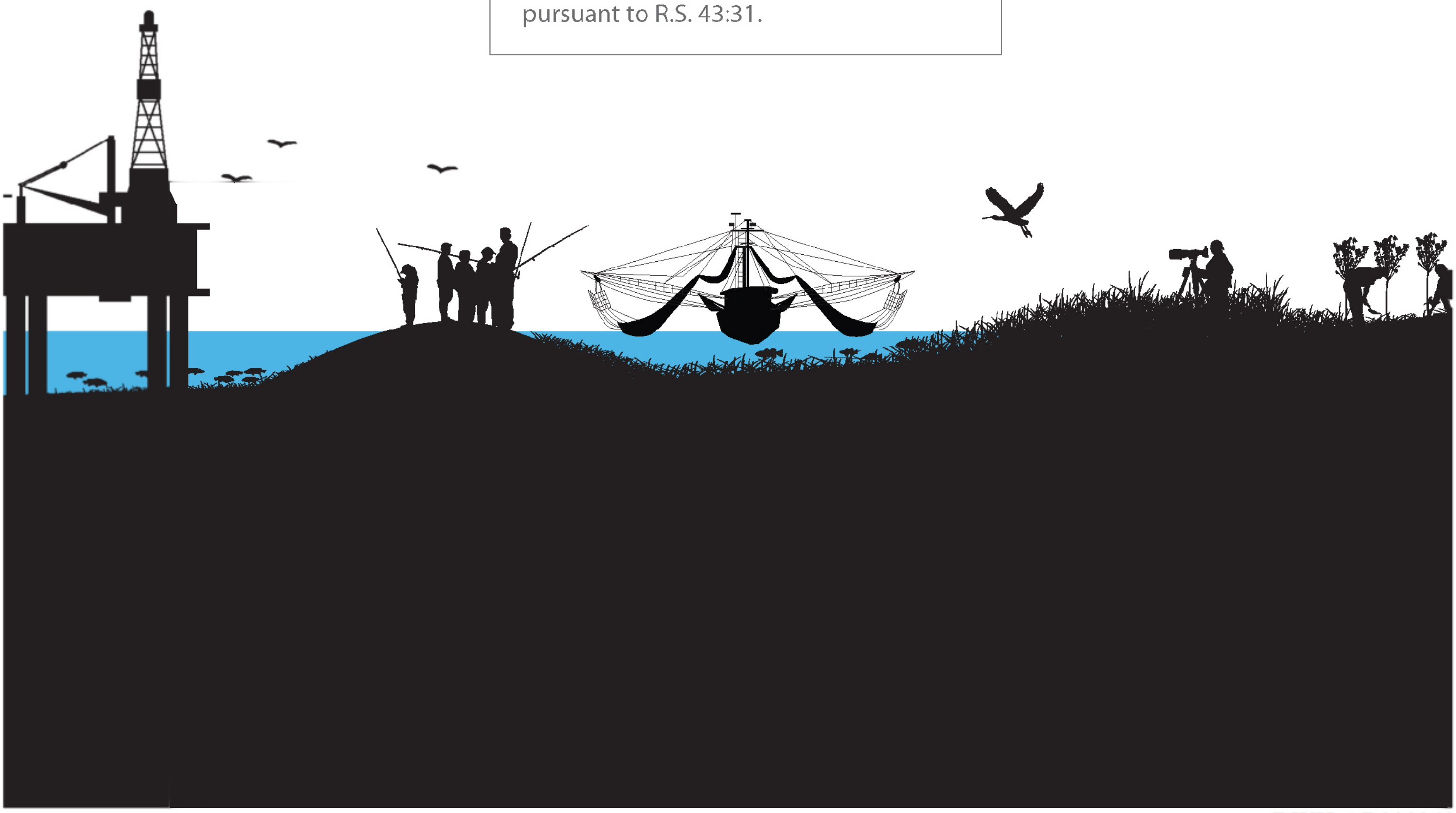
State of Louisiana
The Honorable Bobby Jindal, Governor

Louisiana's Comprehensive Master Plan for a Sustainable Coast

committed to **our coast**

This public document was published at a total cost of $7,879.21. Three hundred fifty copies of this public document were published in this second printing at a cost of $6,737.50. The total cost of all printings of this document, including reprints is $7,879.21. This document was published by the Coastal Protection and Restoration Authority of Louisiana, 450 Laurel Street, Baton Rouge, La 70801, to promulgate the comprehensive master plan, to report to the Louisiana Legislature and inform Louisiana Citizens under authority of R.S. 49:214.5.3. This material was printed in accordance with the standards for printing by state agencies established pursuant to R.S. 43:31.



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Acknowledgements

We would like to thank the citizens, legislators, parish representatives, and stakeholder groups who met with us to share ideas about how to protect and restore coastal Louisiana. We would also like to offer our special thanks to the participants of the 2012 Coastal Master Plan Framework Development Team; the Fisheries, Oil and Gas, and Navigation Focus Groups; the Science and Engineering Board, the Technical Advisory Committees; the Predictive Modeling Workgroup Members; the Subsidence Advisory Panel; and the Marsh Collapse Advisory Panel who took time away from work and family to give us their perspective on coastal protection and restoration issues.

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Contents

Appendices

Appendices for Louisiana's Comprehensive Master Plan for a Sustainable Coast are available on CD or at: coastalmasterplan.la.gov.

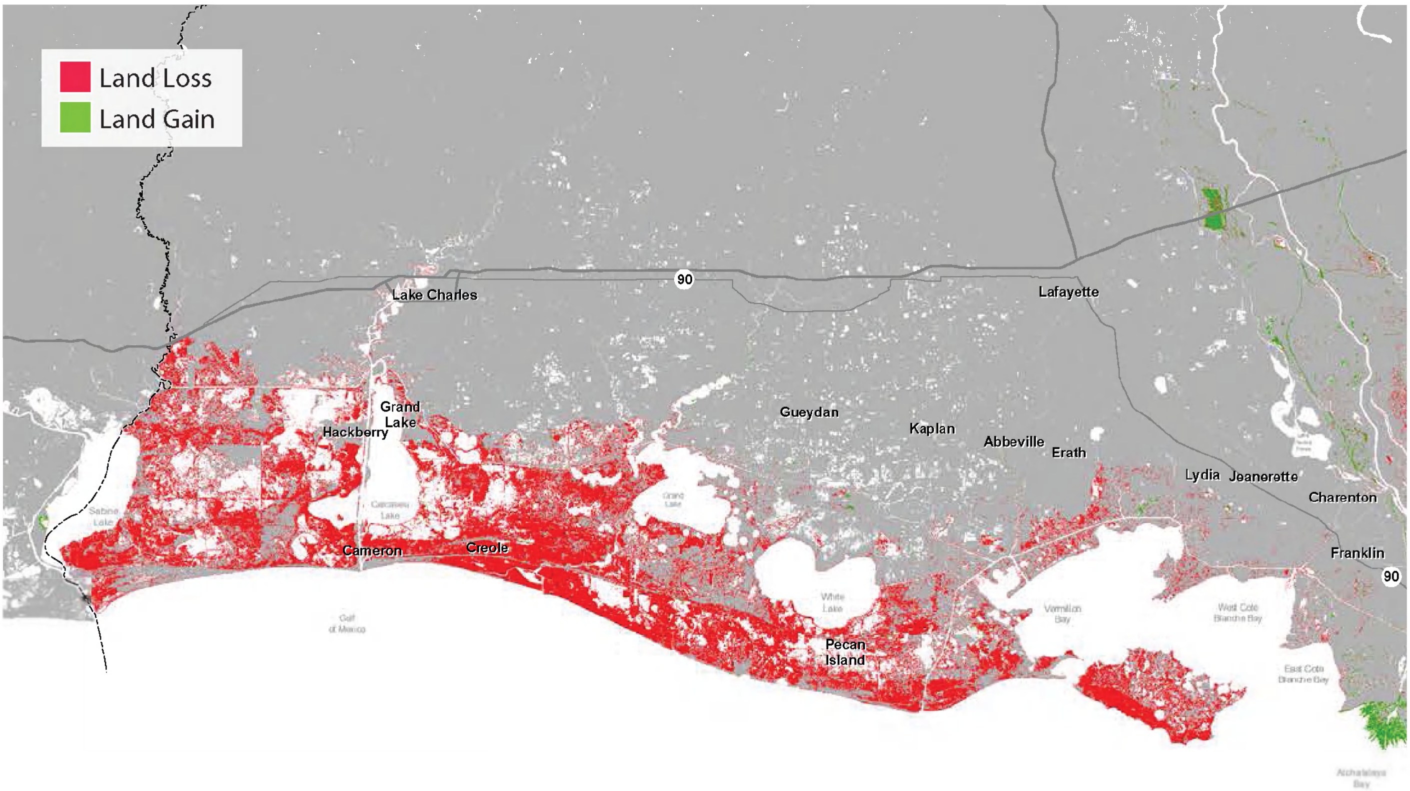
A. Project Definitions
B. Plan Formulation Process
C. Environmental Scenarios
D. Decision Support Tools – Predictive Models
E. Decision Support Tools – Planning Tool
F. Implementation and Adaptive Management
G. Outreach and Engagement
H. Review and Coordination
I. Cultural Heritage
J. Data Compilation Report

Introduction

Construction of Inner Harbor Navigation Canal Surge Barrier.

Louisiana is Experiencing a Coastal Crisis

Predicted Land Change over the Next 50 Years



Louisiana is in the midst of a land loss crisis that has claimed 1,880 square miles of land since the 1930s. Given the importance of so many of south Louisiana's assets—our waterways, natural resources, unique culture, and wetlands—this land loss crisis is nothing short of a national emergency.

If we do not aggressively address this crisis, the problem intensifies. Our analysis confirmed that if we do nothing more than what has been done to date, we have the potential to lose up to an additional 1,750 square miles of land. This land loss will increase flooding risk with disastrous effects. Put simply: the status quo cannot be maintained, and we must take bold action now to save our coast. At the same time, our analysis demonstrated that we do have the opportunity, if we continue to build upon current successes, to avert an otherwise bleak future.

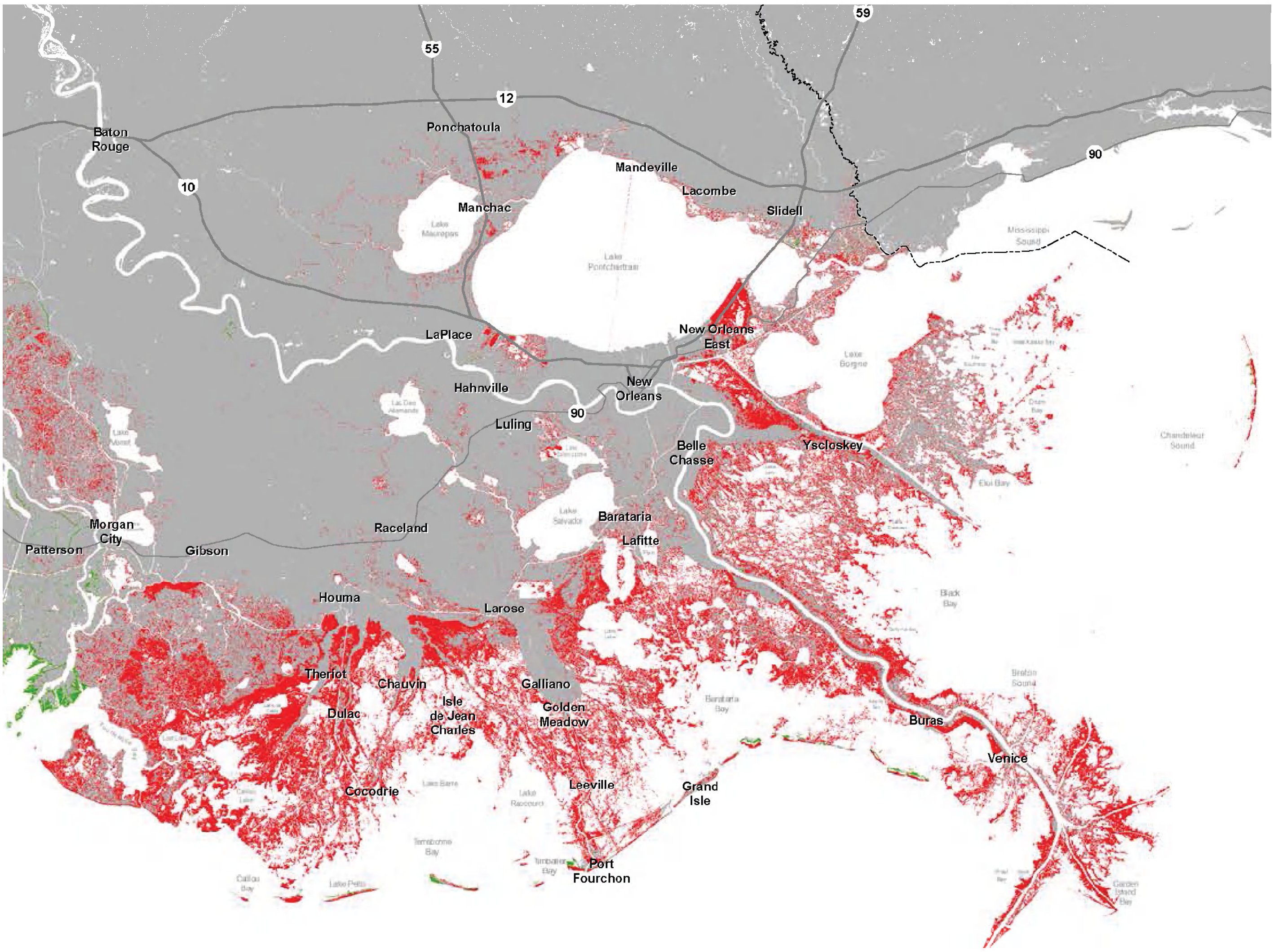
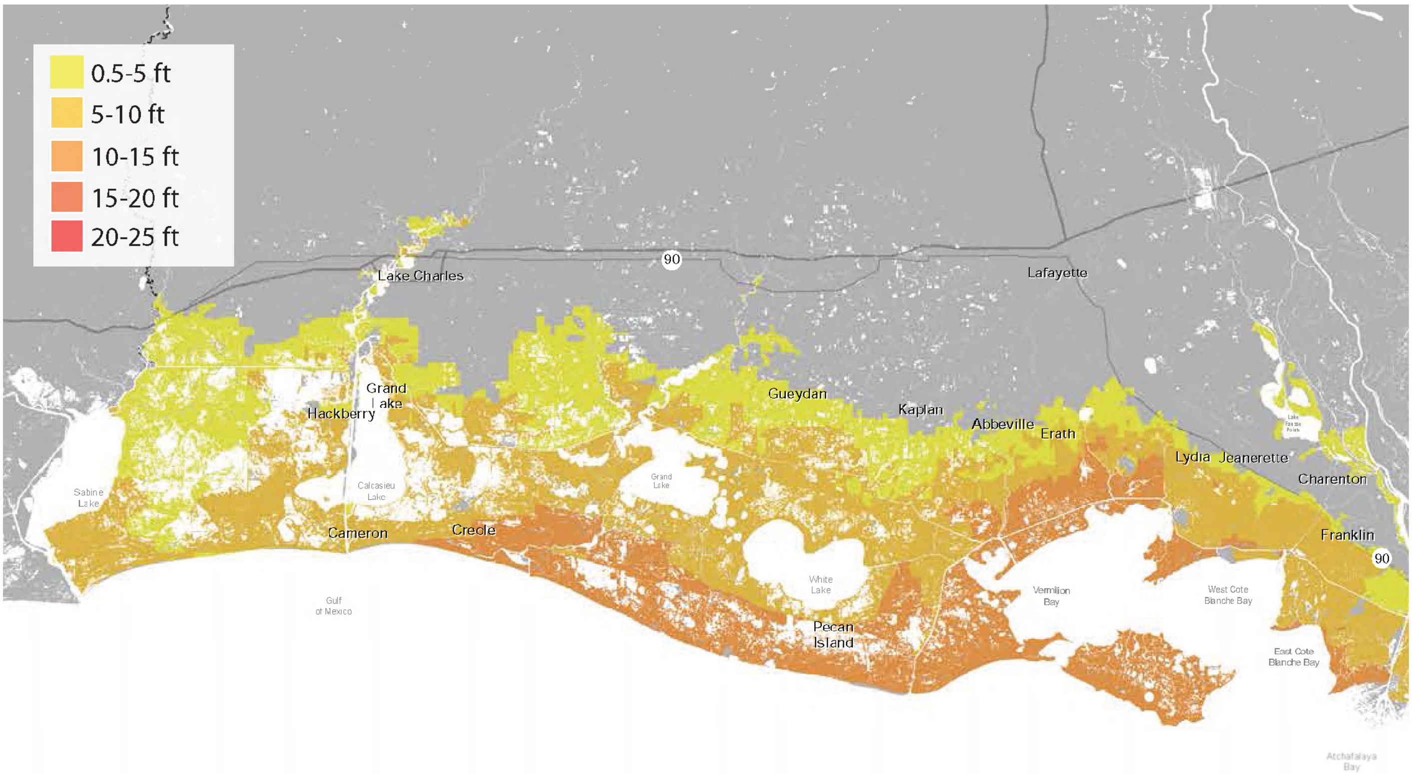


Figure 1
Predicted land change along the Louisiana coast over the next 50 years if we do nothing more than we have done to date. Red indicates areas likely to be lost, and green indicates areas of new land. This map is based on assumptions about increases in sea level rise, subsidence, and other factors. (Estimate based on less optimistic scenario of future coastal conditions. See page 82 and Appendix C for more information.)

Communities and Livelihoods at Risk

Predicted Future Flooding from a 100 Year Flood Event



Barrier islands, marshes, and swamps throughout our coast reduce incoming storm surge, helping to reduce flooding impacts. If we continue to lose these habitats, the vulnerability of communities, nationally important navigation routes, and energy infrastructure will increase substantially. In addition, our flood protection systems will become more vulnerable as the land around them erodes. Our analysis shows if we do nothing more than we have done to date, our expected annual damages from flooding by 2061 would be almost ten times greater than they are today, from a coast wide total of approximately $2.4 billion to a coast wide total of $23.4 billion.

Every day Louisiana citizens are affected by this catastrophe in ways small and large. Whether it is families that must leave cherished communities to move out of harm's way, local businesses that have trouble obtaining insurance, or investments that lose value because of uncertainty about the future of our landscape, Louisiana's land loss disaster takes a heavy toll.

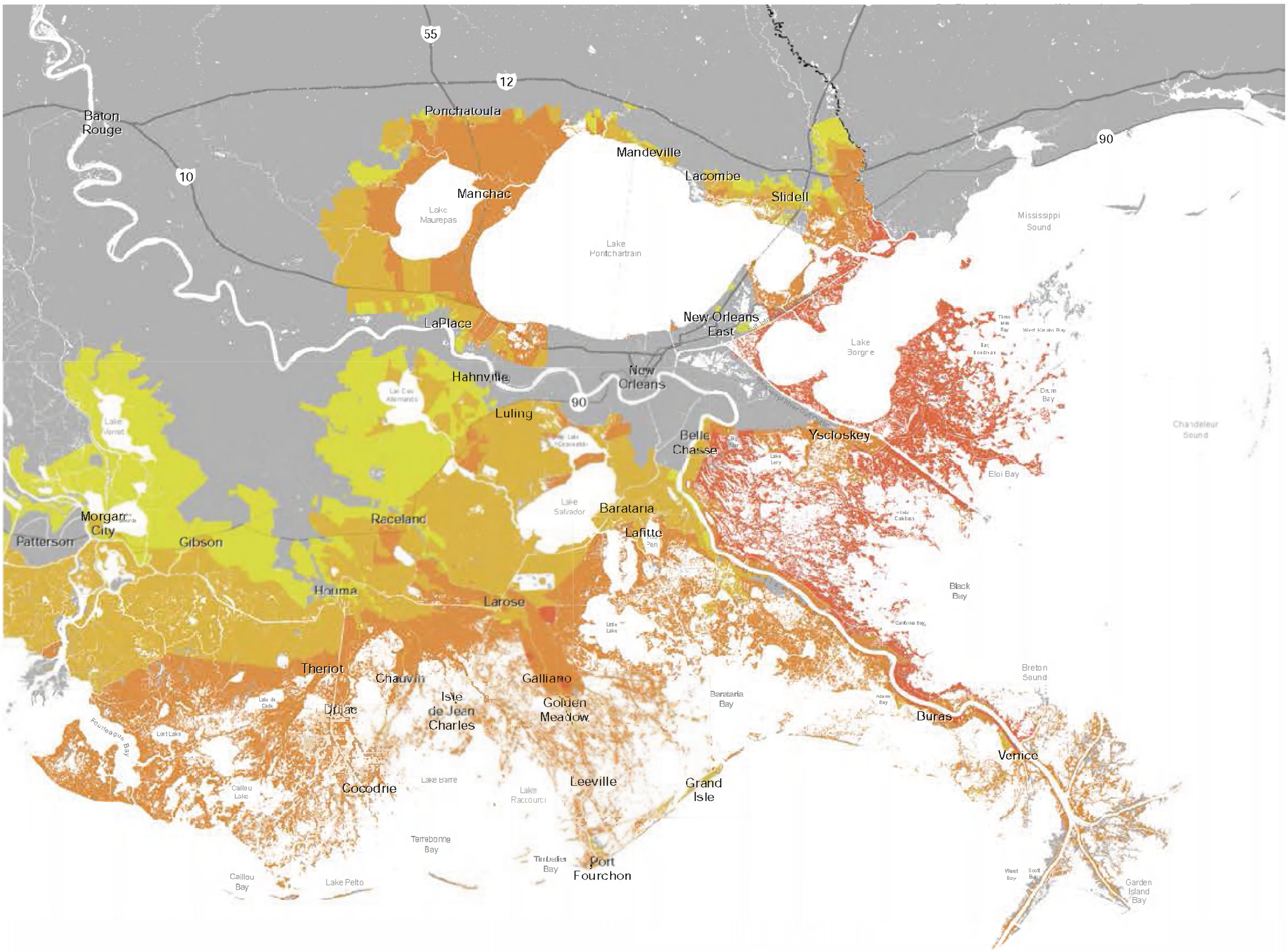
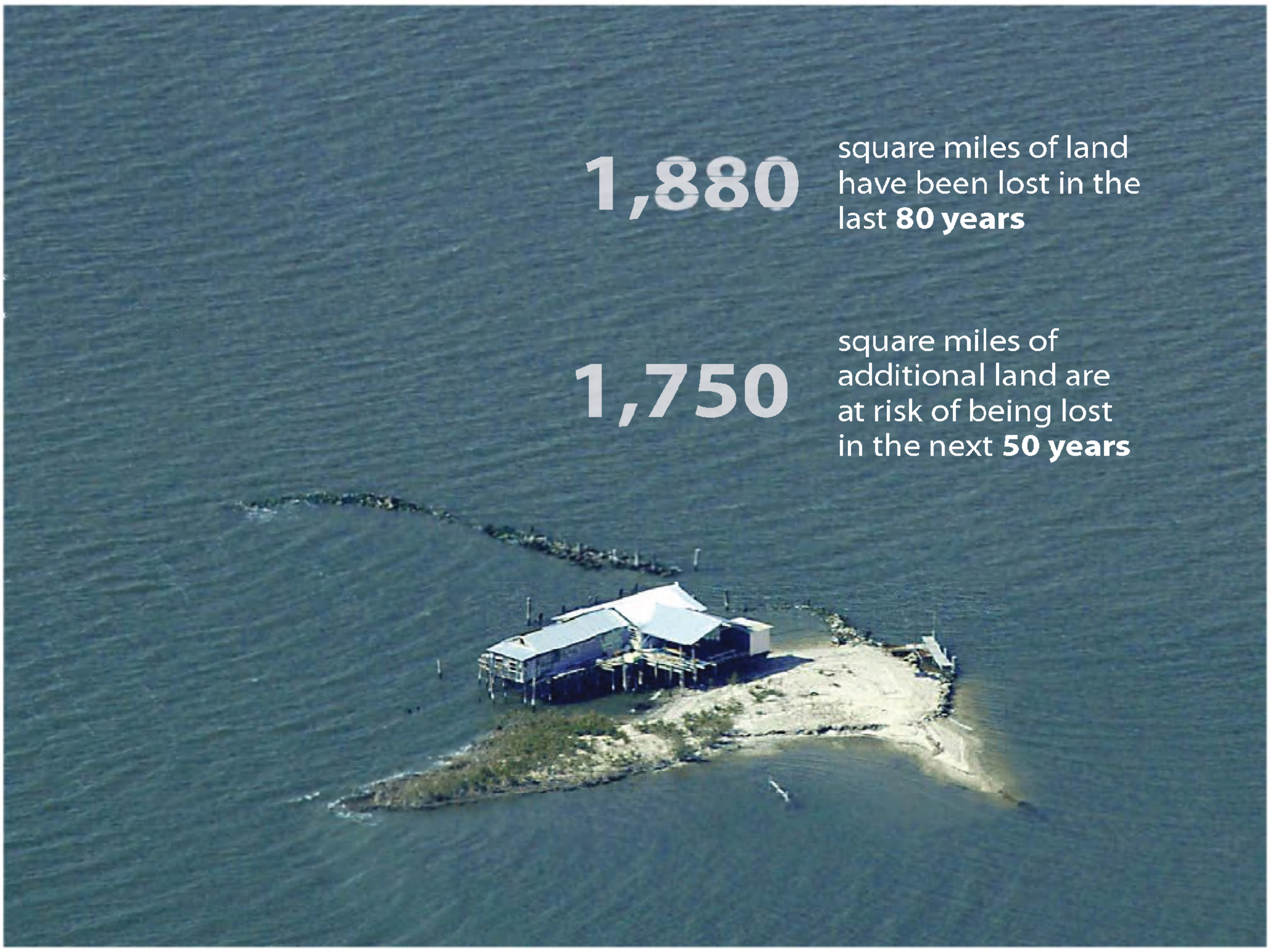


Figure 2
This figure shows generalized estimates of flood depths for a 100 year flood 50 years from now, once the landscape has degraded and with no additional flood protection. These flood depths represent a broad planning level evaluation of overall flooding risk. This map is based on assumptions about increases in sea level rise, subsidence, and other factors. (Estimate based on less optimistic scenario of future coastal conditions. See page 82 and Appendix C.)

What Continued Land Loss Means



Land loss in Louisiana is caused by many different factors, both natural and man made. Levees and floodgates on the Mississippi River have successfully provided national flood control and economic benefits. But these forms of river management have also channeled the Mississippi River and its tributaries into the Gulf of Mexico, depriving the coastal ecosystem of the fresh water and sediment it needs to survive. Dredging canals for oil and gas exploration and pipelines provided our nation with critical energy supplies, but these activities also took a toll on the landscape, weakening marshes and allowing salt water to spread higher into coastal basins. Sea level rise, subsidence, storms, and invasive species add further stress.

The largest environmental disaster in U.S. history, the 2010 Deepwater Horizon oil spill, directly and significantly impacted Louisiana's coast and again highlighted the need for a healthy, resilient coastal ecosystem to better protect our coastal communities and cope with these kinds of unforeseen catastrophes. Responding to the oil spill also diverted critical resources from the state's ongoing efforts to reverse the land loss crisis.

The Ongoing Catastrophe

Hackberry, LA
Hackberry is immensely important to our nation's energy security. The salt domes nearby house one of the nation's four strategic petroleum reserves, with capacity to hold over 228 million barrels of crude oil. This area has already been severely impacted by recent hurricanes. The continued deterioration of the Chenier Plain wetlands nearby will only increase flooding risks, nearly doubling recent flood depths.

Lafitte, LA
Lafitte, a culturally significant town in the Barataria Basin, is experiencing the effects of land loss every day. By 2061, with no action, Lafitte could experience flood depths up to 12 feet from a 50-year storm flood event. This increased risk and continued land loss would be devastating to a fishing community that relies on living close to the coastal ecosystem.

Louisiana Highway 1
LA Highway 1 connects the nation to Port Fourchon, which supplies 18% of our country's oil. Highway 1 experiences repeated closures at high tides as well as storm induced flooding lasting days. This makes Highway 1 an example of infrastructure directly impacted by coastal wetland losses. Without Highway 1, we would not only lose jobs, but the nation would sustain a total economic impact of $7 billion.

A Vital Regional and National Asset

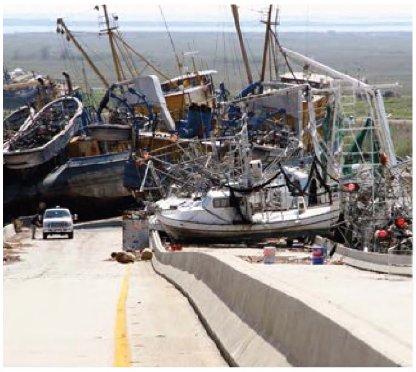
It's easy to list impressive statistics about what Louisiana's working coast provides: protection for infrastructure that supplies 90% of the nation's outer continental oil and gas, 20% of the nation's annual waterborne commerce, 26% (by weight) of the continental U.S. commercial fisheries landings, winter habitat for five million migratory waterfowl. Nowhere in the nation is there a region that simultaneously offers globally important habitat and the breadth of economic assets found in coastal Louisiana.

Important as they are, these facts and figures leave out an essential aspect of the coast's importance—its status as home to over two million people. Many of these residents have lived in and around the coast all of their lives, just as their ancestors have done. Louisiana's coastal residents feel a bond with the coast that brings a unique quality of life to our communities. This bond is based on understanding the land, fishing and hunting its marshes and bayous, drawing our culture from long held ties. Our history and culture are based on our relationship to the coast in ways that few other U.S. regions can match. This was well expressed by one of the public comments we received, which quoted a well known Native American saying, "Treat the earth well. We do not inherit it from our ancestors; we borrow it from our children."

The impact of Louisiana's coast extends throughout the Gulf of Mexico. The fresh water and habitats our state provides directly affect the health and biodiversity of the entire gulf region. The federal Gulf Coast Ecosystem Restoration Task Force recognizes Louisiana's coast as integral to restoring the health and resilience of the entire Gulf of Mexico ecosystem.

Port Fourchon is strategically important to the Gulf Coast and the nation as a whole. It provides a vital port and supply point for 90% of the offshore drilling operations in the Gulf of Mexico.

Our Obligation to Act



The coast is critical to our nation's economy and woven into the identity of our communities. Indeed, the coast is such a part of our daily lives that its bounty can be hard to appreciate. But when we step back, we recognize how vital this region is—not just for what it does, but for what it is. Saving it must be a national priority.

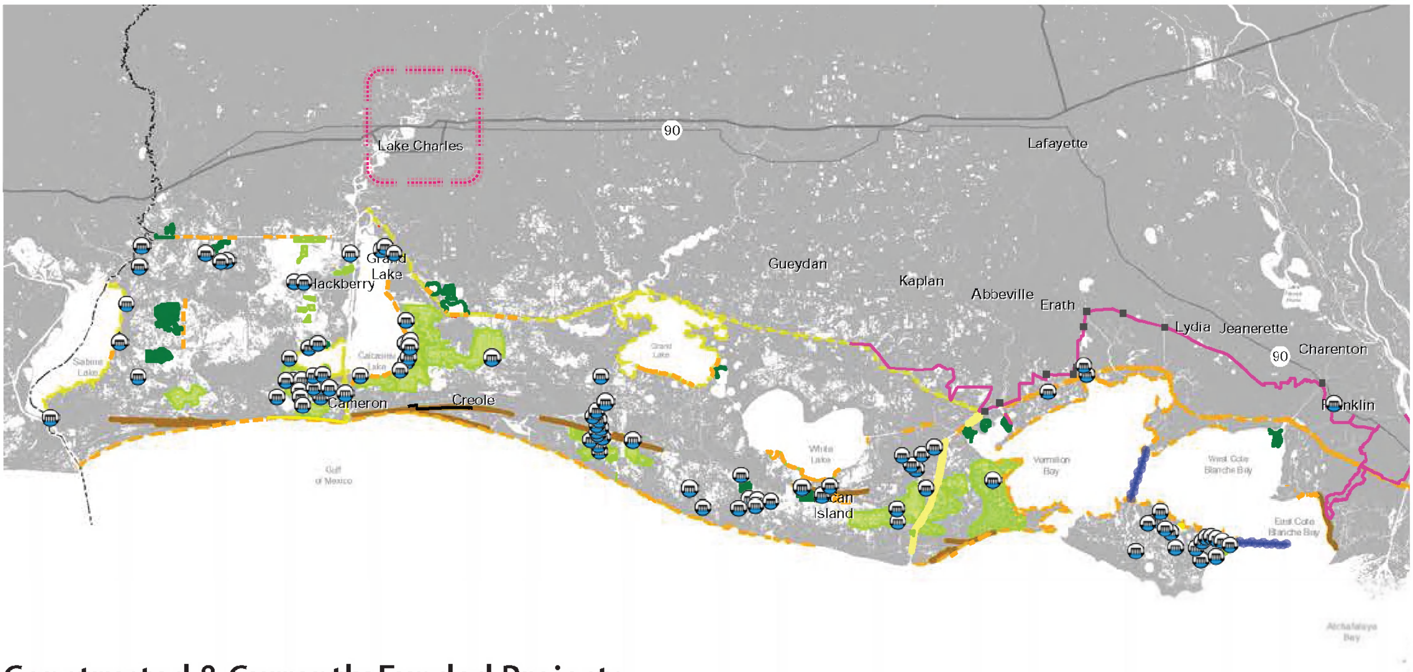
The catastrophe facing south Louisiana means that we must act quickly, or we will lose everything. Our communities will continue to wash away, our fisheries will collapse, and vital industries will not have the infrastructure or workforces they need to operate. The costs of inaction are enormous:

- Should land loss continue unabated, the nation would face costs of approximately $40 billion just to handle the retreat of communities inland.
- Damage to the network of pipelines in and around Louisiana's coast would result in U.S. consumers paying billions in increased energy costs.
- The reactionary expenditures required after Hurricane Katrina were $250 billion. Future storms could have similarly devastating impacts.

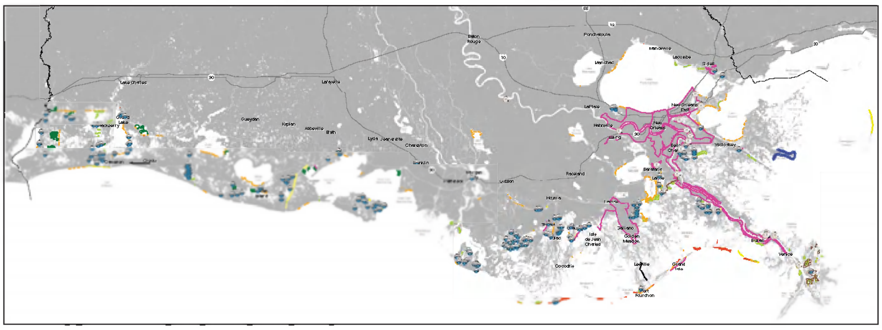
These outcomes are wholly unacceptable. To prevent them as stewards of the public trust, we must pursue bold coastal protection and restoration measures. We do so knowing that none of the actions included in this plan will cause more distress and dislocation than continuing on our current path.

Responding to the Crisis

Louisiana's Coastal Program: Past, Present, and Future



Constructed & Currently Funded Projects



2012 Coastal Master Plan: Future Projects

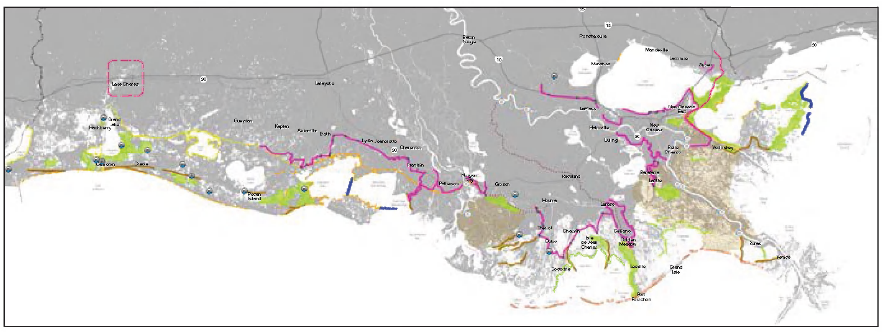


Figure 3
Saving our coast requires a diversity of projects throughout our communities. The smaller map to the left (upper)shows projects that have been or are being constructed. The map to the left (lower) shows future projects in the 2012 Coastal Master Plan. The large map combines both sets of projects to show the complete scope of the state's work for Louisiana's coast.

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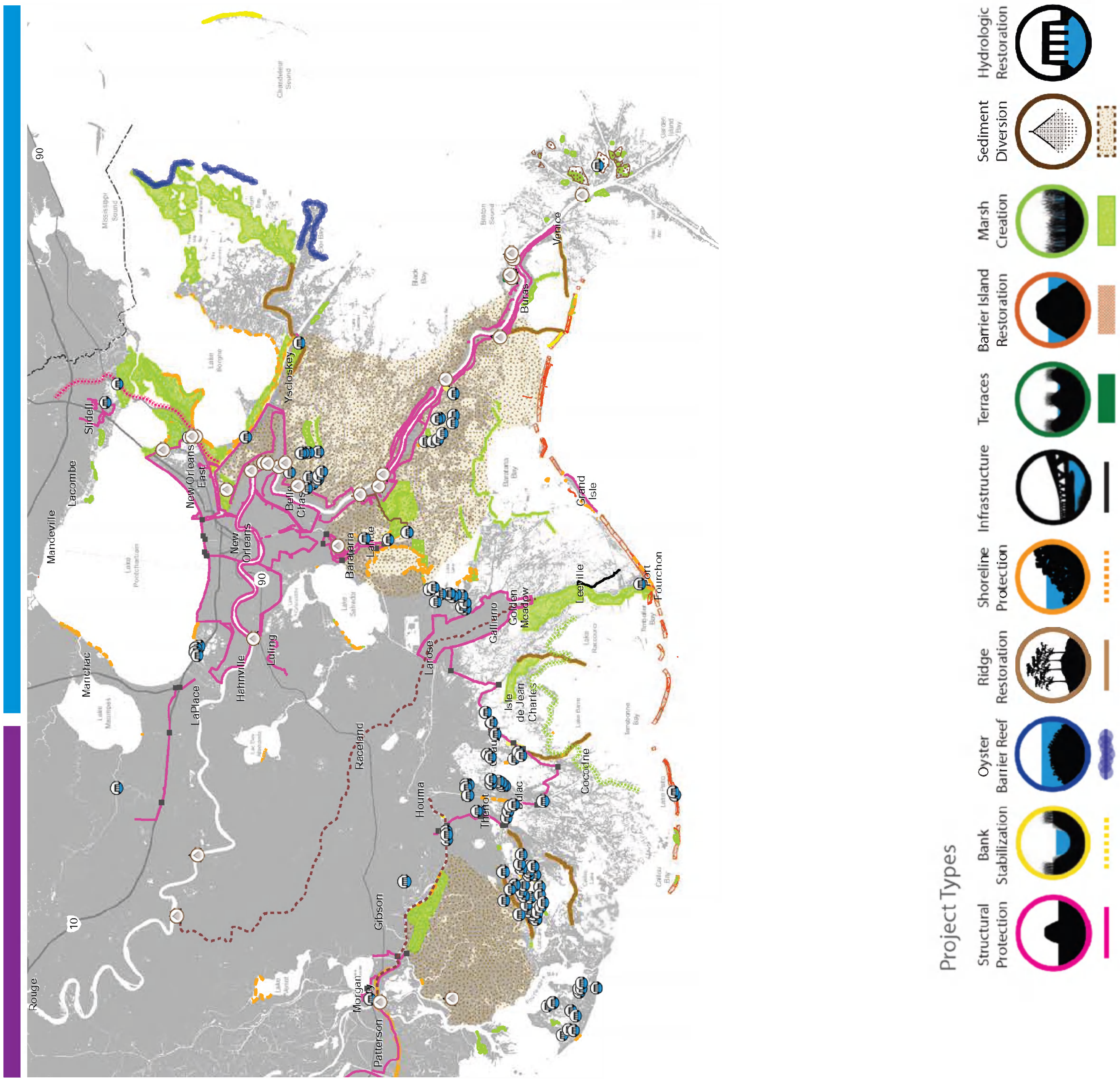
Mandeville
Lacombe
Slidell
New Orleans East
New Orleans
Belle Chasse
Ycloskey
Buras
Venice
Barataria
Lafitte
Grand Isle
Port Fourchon
Leeville
Golden Meadow
Galliano
Larose
Luling
Hahnville
LaPlace
Manchac
Raceland
Houma
Isle de Jean Charles
Cocodrie
Gibson
Morgan City
Patterson
Rouge
Project Types
Structural Protection
Bank Stabilization
Oyster Barrier Reef
Ridge Restoration
Shoreline Protection
Infrastructure
Terraces
Barrier Island Restoration
Marsh Creation
Sediment Diversion
Hydrologic Restoration

Building on Recent Successes

People and businesses all over the country are affected by Louisiana's ongoing land loss catastrophe, but the impacts hit us here at home first. Citizens see their landscape washing away, and they fear the worst when storms approach our coast. Instead of waiting for others to tackle these problems, the state has taken a leadership role and identified specific projects that will sustain coastal communities, habitats, and the Louisiana culture we all treasure. These measures address the root causes of land loss and will allow citizens to return to their communities and jobs with more certainty after a storm.

After Hurricanes Katrina and Rita, the Louisiana Legislature directed our state to respond to the land loss crisis in a new way. Act 8 of the First Extraordinary Session of 2005 created the Coastal Protection and Restoration Authority of Louisiana and required that it develop a plan for a safe and sustainable coast. The legislature required that this plan be updated every five years to ensure that the state was building on success and taking maximum advantage of new science and innovation. The legislature further directed that the plan include large scale projects and take the needs of the entire coast into account. Most importantly, the plan had to prepare the way for action. The 2007 Coastal Master Plan was the first such plan, and it helped support the many protection and restoration projects that have since been implemented.

In the last five years, the state has exponentially increased its financial commitment to the coast. Some of these dollars provided the state's match for repairs and revisions to the Greater New Orleans area levees, allowing the state to leverage over $14 billion in federal dollars for this vital hurricane protection system. In addition, the federal Coastal Impact Assistance Program (CIAP) is providing approximately $496 million to Louisiana to mitigate impacts from Outer Continental Shelf oil and gas production. Many of the CIAP projects address coastal restoration needs through shoreline protection, marsh creation, and other strategies. Approximately 90% of the CIAP program's projects are underway or complete.

We've achieved good things and learned a great deal from our efforts; we need to keep the momentum and think even bigger. Most important, we understand that trying to maintain the status quo is not only futile, it is a recipe for disaster. However, by embracing the need for constructive change, we can protect our communities and help sustain the coast.

The Coastal Protection and Restoration Authority

The Coastal Protection and Restoration Authority's (CPRA) mandate is to develop, implement, and enforce a comprehensive protection and restoration master plan for coastal Louisiana, defined by the area in Louisiana that falls south of the Old River Control Structure (see Appendix A). In partnership with federal, state, and local government, including levee districts, the CPRA is working to establish a safe and sustainable coast to protect our communities, the nation's critical energy infrastructure, and our bountiful natural resources for generations to come.

Since 2007, the Coastal Protection and Restoration Authority has:

- Built or improved 159 miles of levees
- Benefited 19,405 acres of coastal habitat
- Secured approximately $17 billion in state and federal funding for protection and restoration projects
- Identified and used dozens of different federal, state, local, and private funding sources for projects
- Moved over 150 projects into design and construction
- Constructed projects in 20 parishes
- Constructed 32 miles of barrier islands/berms

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Progress on the Ground: Achievements Since 2007

Before & After

Since 2007 the state has exponentially increased its financial commitment to the coast. Some of these dollars provided the state's match for improvements to the Greater New Orleans area levees, allowing the state to leverage over $14 billion in federal dollars for this vital hurricane protection system. In addition, the federal Coastal Impact Assistance Program (CIAP) is providing approximately $496 million to Louisiana to mitigate impacts from Outer Continental Shelf oil and gas production.

Dedicated Dredging on the Barataria Basin Landbridge

Approximately 5.5 million cubic yards of material was placed in two contained marsh creation areas to create 1,211 acres of intertidal marsh. An additional 4 million cubic yards of material was placed in adjoining fill areas to nourish 1,578 acres of marsh. This project was completed in 2010 at a total cost of $36.3 million, and funded through CWPPRA, CIAP, and State Surplus funds.

Goose Point Marsh Restoration

Constructed in 2009, this project created 437 acres of marsh and nourished 114 acres of degraded marsh along the northern shoreline of Lake Pontchartrain. The project was implemented through CWPPRA at a cost of $20.8 million.

Grand Isle Barrier Island Restoration

The project included placement of 450,000 cubic yards of sand. This was used to create a vegetation covered sand dune reinforced with a sand filled geotextile tube, scour apron, and sand filled anchor tube system. The resulting sand dune is approximately 200 feet wide and 38,600 feet (7.3 miles) long.

The 2012 Master Plan is the Way Forward

Making realistic, on the ground progress toward restoring coastal habitats and protecting communities—demonstrating our commitment to the coast—is at the heart of the 2012 Coastal Master Plan. We developed the plan by taking a look 50 years into south Louisiana's future and building world class science and engineering expertise into understanding what we could achieve. The plan presents the best use of dollars based on what we know today—the first time the state has identified specific large scale actions for our coast.

Given the rapid pace of change that is part of our landscape, we can neither turn back the clock and return the coast to its historic condition nor keep the coast just as it is today. As we confront the challenge of living in a dynamic coastal system, we must create a new and vibrant coast—one with sustainable communities, infrastructure, and ecosystems. Our analysis has shown that with the right mix of projects and funding we can offer substantially improved risk reduction to our communities and make strides toward building a sustainable ecosystem that is resilient over time. Since the 2007 Master Plan was released, we have built more levees, restored more land, and invested more dollars than any time in the state's history. Now is the time to use this momentum and take our coastal program to the next level. When we do, we will be ensuring that current and future generations will enjoy the protection and natural resource benefits that a healthy coast provides.

Potential Expected Annual Damages from Flooding at Year 50

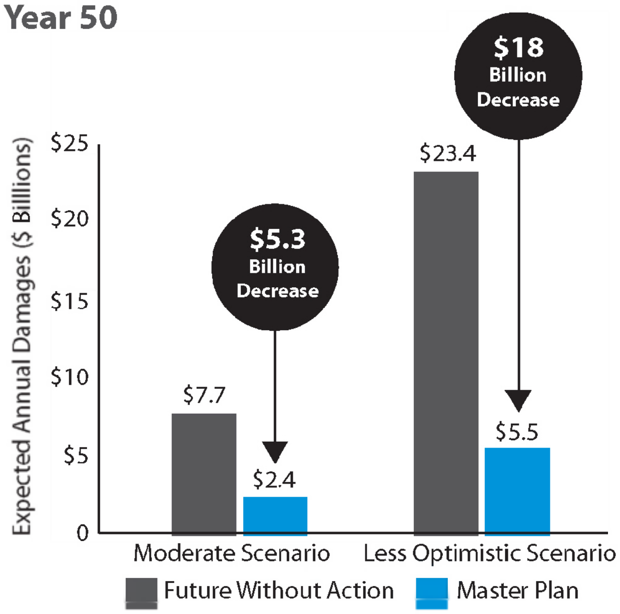

Figure 4 The master plan can provide significant decreases in our future risk. Potential expected annual damages for Future Without Action and future with the master plan at Year 50.

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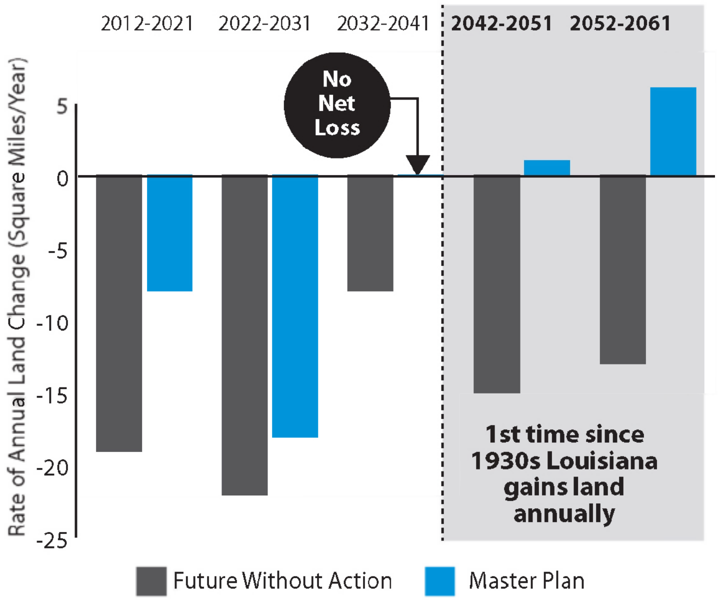
Figure 5
According to the U.S. Geological Survey, Louisiana currently loses over 16 square miles of land per year. This figure depicts potential changes in the annual rate of land loss/gain every 10 years based upon the moderate scenario of future coastal conditions. Implementation of projects in the master plan may result in no net loss after 20 years and annual net gain after 30 years.

Potential Annual Rates of Land Change over the Next 50 Years



What If…Evaluating Future Coastal Conditions

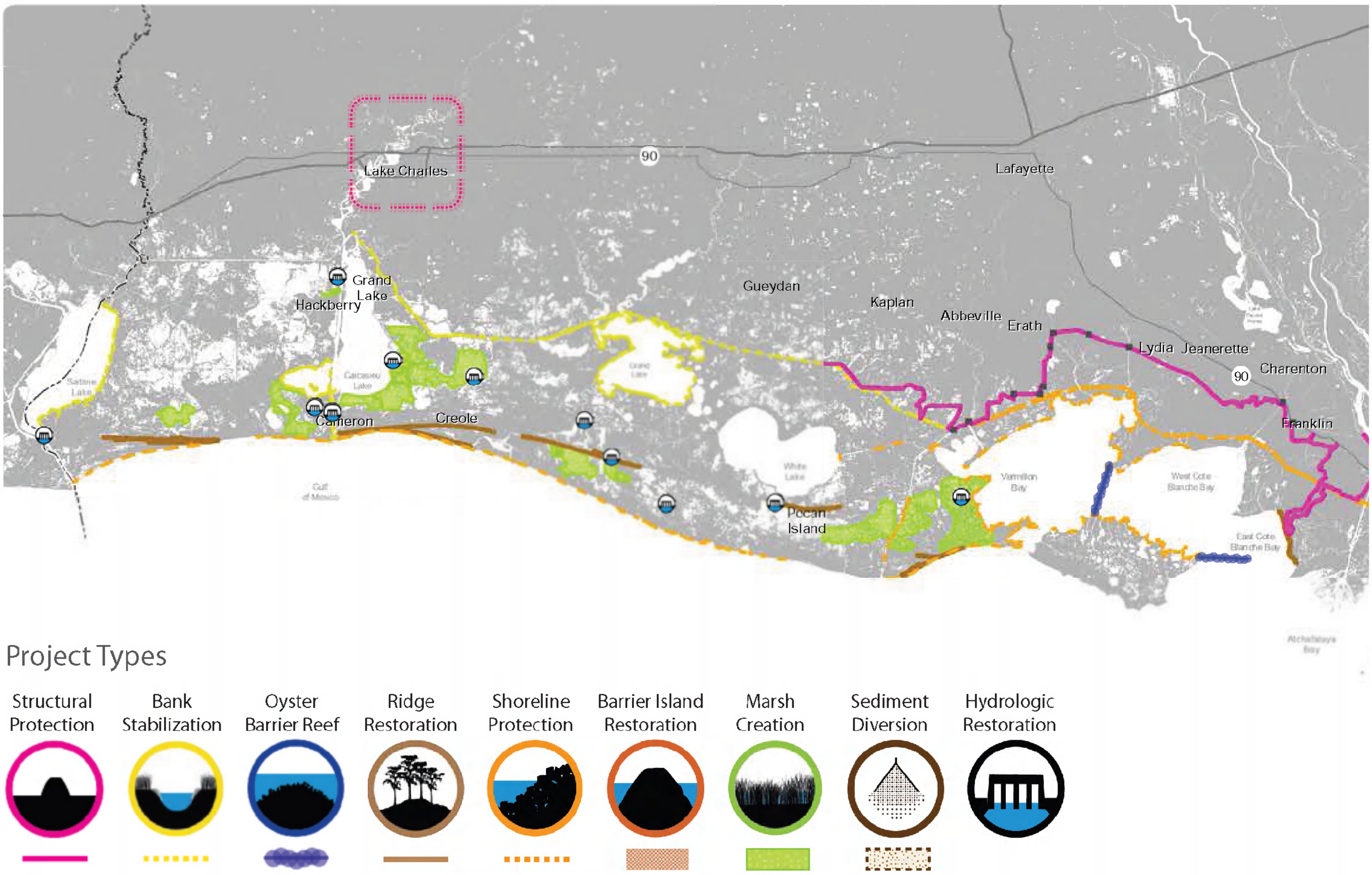
We evaluated two scenarios of future coastal conditions to gain a better idea of how our projects would perform in an uncertain future. Possible land building results according to our moderate scenario are presented in Figure 5. Results for the less optimistic scenario are below:

- Without further action, over the next 50 years we could experience land loss rates ranging from 15 to 51 square miles every year, for a total loss of 1,750 square miles. This would result in a doubling of the land loss that we have experienced from the 1930s to today.

- With the master plan, we make steady improvements in land gain until we reach over 30 square miles of land gain per year by Year 50. Over the 50 years of project implementation, the master plan could potentially build or sustain up to 800 square miles of land. We do not completely offset land loss in those 50 years under less optimistic conditions, but we significantly improve our resilience by building or sustaining this land.

For more information about scenarios, see p. 82 and Appendix C.

2012 Coastal Master Plan



▲ Figure 6
Projects included in the 2012 Coastal Master Plan.

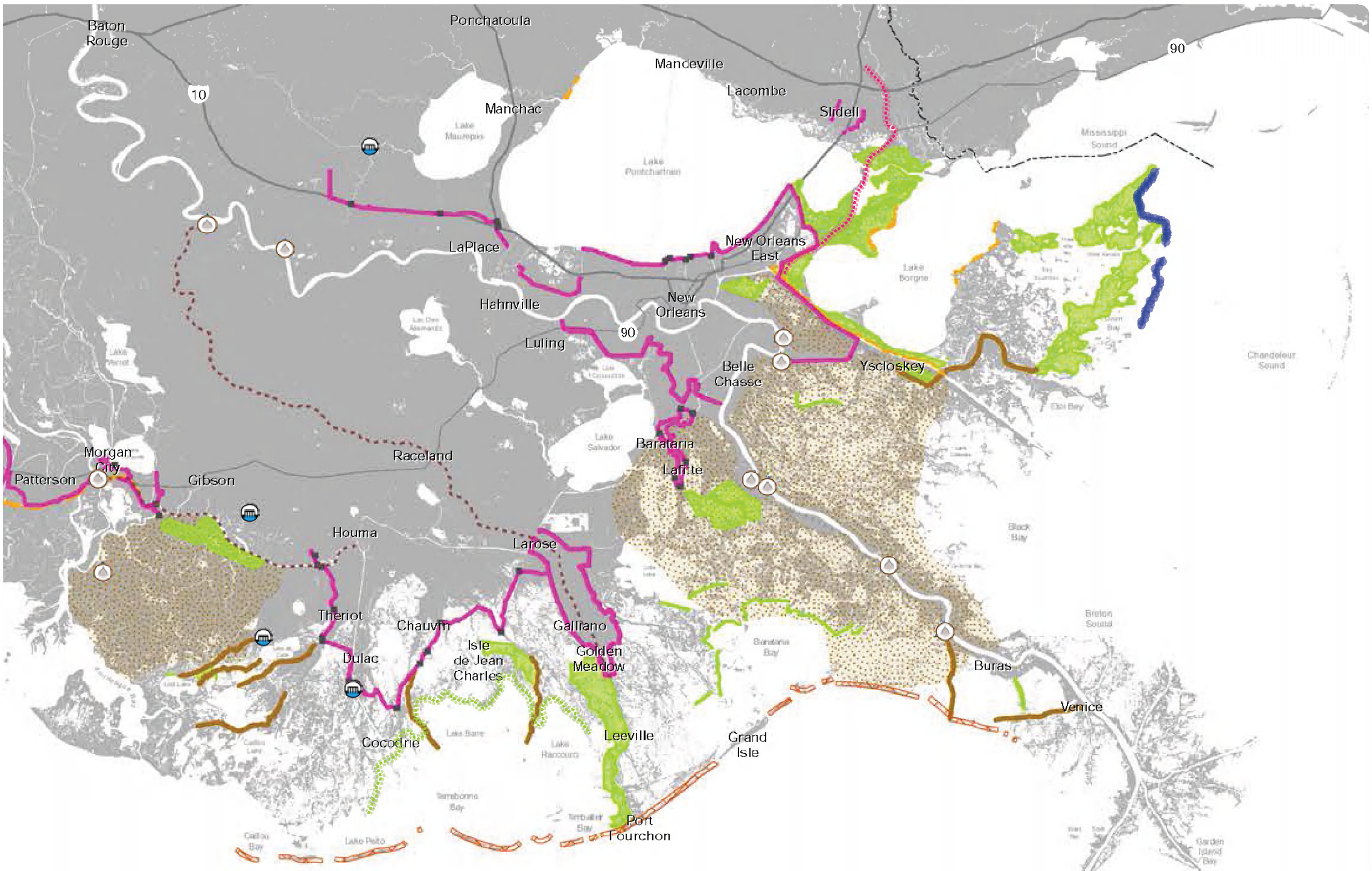
Note
Map does not show nonstructural projects that the plan provides in each coastal parish. Structural measures mainly refer to levees, flood walls, and pumps that protect large areas. Nonstructural measures refer mainly to risk reduction actions that homeowners and businesses can individually take, such as elevating or flood proofing.

The 2012 Coastal Master Plan was developed through a ground breaking technical effort and extensive public outreach. Through this effort, we identified the projects shown here. These projects will substantially increase protection for communities and make great strides toward achieving a sustainable coast. They include a diverse mix of projects throughout the coast, from the Chenier Plain to the Mississippi border.

Overall Goals

Protection. Use a combination of restoration, nonstructural, and targeted structural measures to provide increased flood protection for all communities.

Restoration. Use an integrated and synergistic approach to ensure a sustainable and resilient coastal landscape.



Southwest Coast

Protection

Protection measures are included for large, densely populated, at risk communities, such as Lake Charles and Abbeville. Nonstructural measures are included for all parishes in this region. Restoration of chenier ridges, gulf shore protection, and wetlands contribute additional storm protection.

Restoration

Restore wetlands and chenier ridges while limiting saltwater intrusion. Maintain and increase, where possible, the input of fresh water to maintain a balance among saline and fresh wetlands.

Central Coast

Protection

Levee protection is included for large, densely populated, at risk communities, including Morgan City, Franklin, New Iberia, and Houma. Nonstructural measures are included for all parishes in this region. Restoration of barrier islands, marshes and ridges contribute additional protection.

Restoration

Sustain the land building capacity of the Atchafalaya region, while increasing the use of Atchafalaya River sediment and water east to Terrebonne Parish to sustain the coastal ecosystem. Rebuild barrier islands, marshes, and ridges.

Southeast Coast

Protection

Sustain key levee protection systems, such as Greater New Orleans area and Larose to Golden Meadow. New levees are included for large, densely populated, at risk communities, such as LaPlace, Lafitte, and Slidell. Nonstructural measures are included for all parishes in this region.

Restoration

Use sediment and water from the Mississippi River to sustain and rebuild land. Sustain a diversity of coastal habitats including cypress swamps, marshes, ridges, and barrier islands.

What the 2012 Coastal Master Plan Delivers

- The plan improves flood protection for every community in coastal Louisiana, at a minimum through nonstructural programs. These improvements, along with the information about remaining flood risks that the plan offers, will provide added certainty to coastal residents about the benefits they can expect in the future.
- The plan's projects would reduce expected annual damage from flooding throughout Louisiana's coast by $5.3 to $18 billion.
- Levees that significantly reduce or eliminate risk from a 100 year storm are provided for communities such as Abbeville, New Iberia, Morgan City, Houma, Golden Meadow, and Lafitte. This level of protection will reduce risks for residents and provide more certainty for businesses and industries.
- Measures that significantly reduce or eliminate flooding risk from a 500 year storm are included for the Lake Charles and Greater New Orleans areas.
- Nonstructural programs are designed to help residents improve their resilience in the face of storms. The plan provides options for flood proofing and residential elevations. A limited number of voluntary acquisition measures will be further developed in close consultation with communities.
- According to our moderate scenario of future coastal conditions, the projects in the plan have the potential to achieve no net loss of land coast wide in 20 years. Under the same scenario in 30 years, Louisiana's coast has the potential to experience an annual net gain in land. Although variable at different locations across the coast, this fundamental change in our coast's condition is the building block for a secure future.
- By the end of 50 years, the restoration projects in the plan have the potential to build or sustain between 580 and 800 square miles of land. This translates into new habitats, improved storm buffering capacity, and more security for coastal residents and businesses compared to Future Without Action conditions.
- The land building benefits provided by many of the restoration projects in the plan will continue well beyond 50 years. These long term benefits will support the continued international preeminance of Louisiana's navigation industry as well as the increased competitiveness of our ports, while providing healthy habitats for commercial and recreational species.
- The plan includes the nation's largest investment, over $20 billion, in sediment mining and marsh creation projects that will provide land building benefits for areas in dire need.
- Restoration projects in the plan contribute to overall risk reduction across the coast by reducing storm surge.

- By increasing flood protection and building or sustaining land, the plan supports coastal industries, their infrastructure, and the workforce they depend on.
- The ecosystem sustainability provided by the plan will support robust commercial and recreational fisheries coast wide, along with other ecosystem services that benefit our communities.
- The plan will allow us to transition with our changing environment, sustaining our unique cultural heritage, communities, and livelihoods.
- The plan invests in restoring barrier islands, headlands, and shorelines, not only as critical habitats but as first lines of defense against storm surge.
- The plan includes a wide variety of project types distributed throughout the coast. We are using every tool in the toolbox to protect and restore south Louisiana.
- The master plan supports the goals of the Gulf Coast Ecosystem Restoration Task Force's Regional Ecosystem Restoration Strategy and provides the framework for supporting the health of all of the Gulf's ecosystems.
- The plan provides tremendous economic development opportunities for Louisiana and its citizens.
- The projects in the plan would use up to 50% of the Mississippi River's peak flow for sediment diversions, in addition to using water and sediment from the Atchafalaya River.

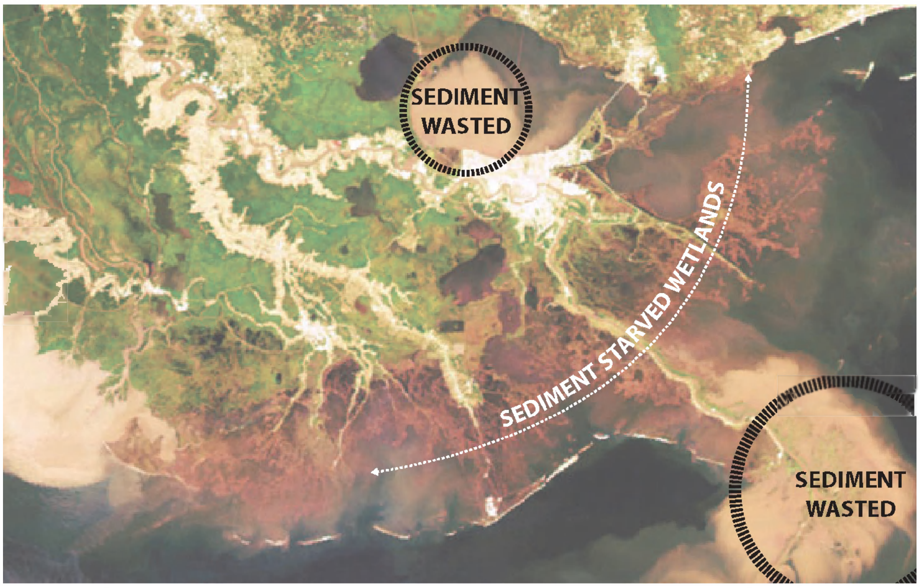


Figure 7
The high water event of 2011 brought massive amounts of sediment to coastal Louisiana. Unfortunately, much of this sediment was not delivered to the sediment starved wetlands but instead was shunted into open water, including the deep gulf. The 2012 Coastal Master Plan will allow us to capture sediment and rebuild the wetlands of south Louisiana.

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Figure 8
The master plan is based on a total budget of approximately $50 billion. This chart shows the distribution of funding in the master plan by project type.

Distribution of Funding by Project Type (Approximately $50 billion)

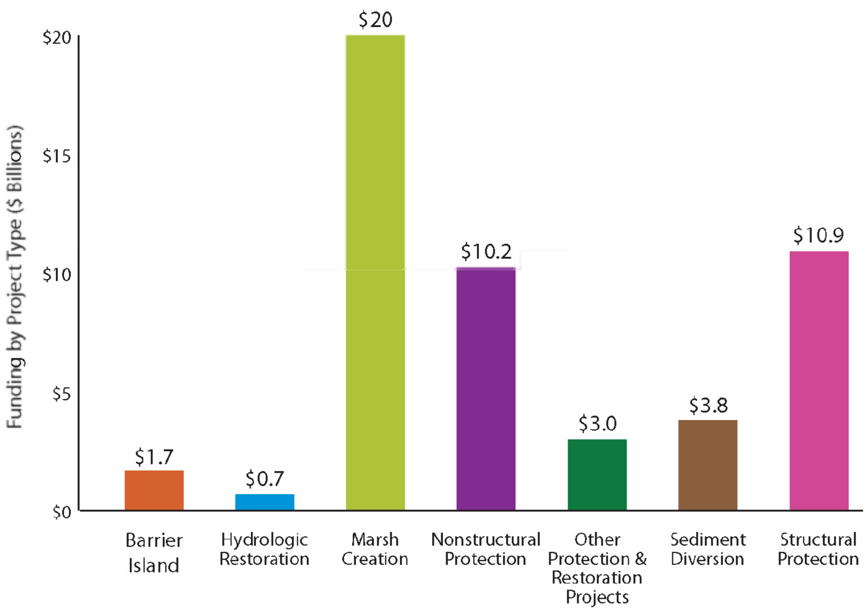
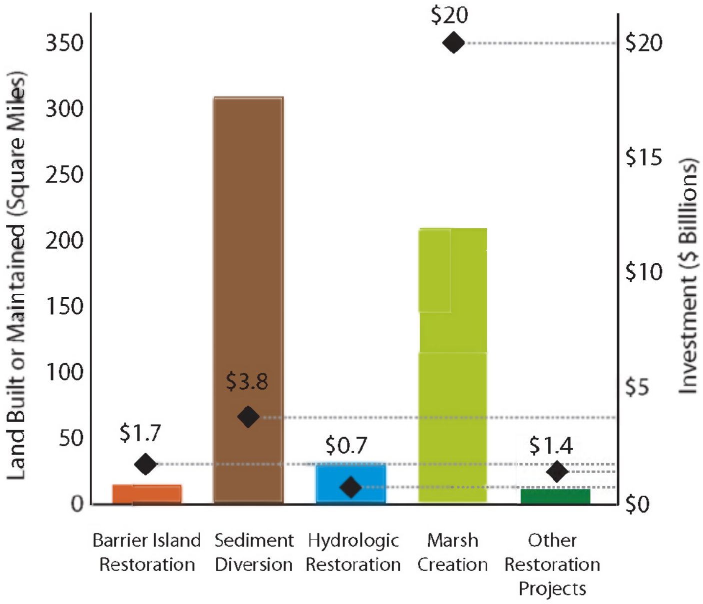


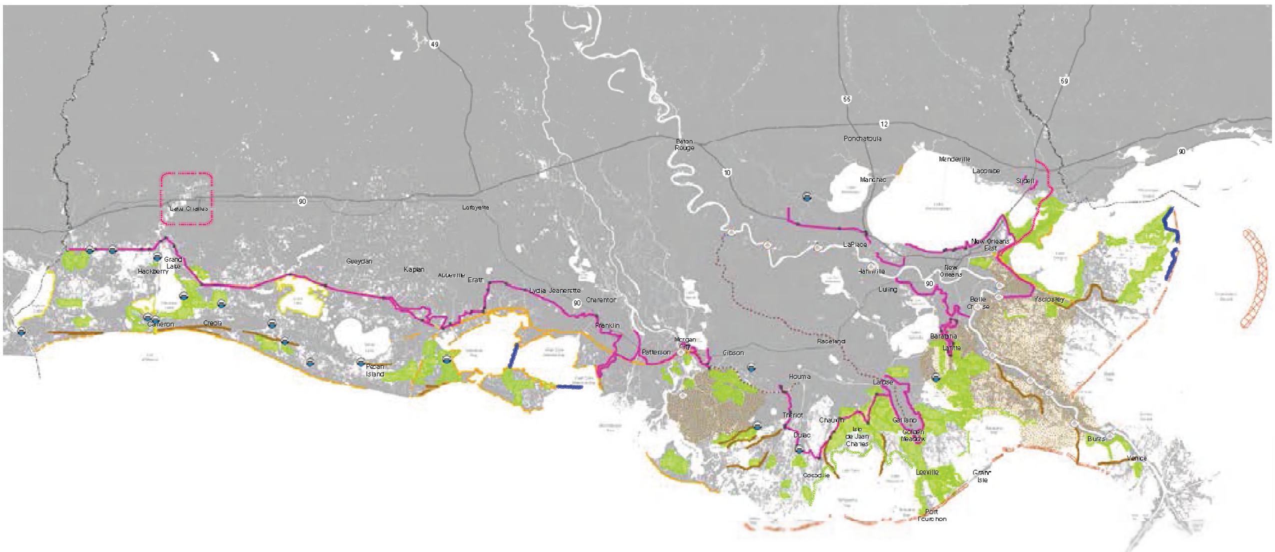
Figure 9 Total land building at Year 50 by restoration project type and the investment required to implement projects. (Estimates based on moderate scenario of future coastal conditions.)

Long Term Land Building and Investment by Restoration Project Type



Greater Possibilities

Potential Projects with $100 Billion Investment



▲ **Figure 10**
Map represents the $50 billion worth of projects comprising the 2012 Coastal Master Plan, plus an additional investment of $50 billion for the coast.

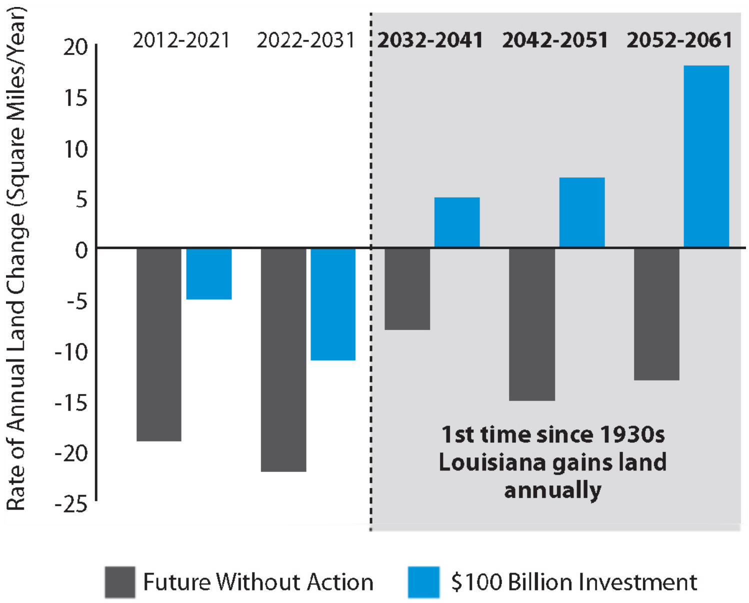
The 2012 Coastal Master Plan is a solid foundation on which to continue building Louisiana's coastal program. The budget we used for the plan, $50 billion, reflects existing and potential funding sources. Targeted use of these dollars as described in this plan will allow us to improve protection for communities and, depending on how future coastal conditions change, turn the tide of land loss in Louisiana for the first time in a century. With all the good this plan could achieve, we won't be able to completely compensate for the land loss that will occur over the next 50 years.

The Coastal Protection and Restoration Authority is committed to making the most of every opportunity to secure south Louisiana's future. For this reason, we evaluated what we could deliver for coastal citizens with a budget larger than $50 billion. Our goal in doing so was to see how much funding it would take to build or sustain large amounts of land and maximize protection of our communities beyond what we accomplish in this plan.

Our analysis showed that additional funds would increase our ability to protect at risk communities and build coastal land. For example, by 2061 a budget of $100 billion would allow us to achieve a net gain of land even under less optimistic future coastal conditions. With the $100 billion investment, the Louisiana coast could build or sustain between 910 and 1,240 square miles of land by 2061 and be building or sustaining land coast wide at a rate between six and 18 square miles per year, depending on future coastal conditions.

Figure 11 Potential changes in the annual rate of land loss and land gain every 10 years with a $100 billion investment under the moderate scenario of future coastal conditions. A larger investment provides the potential for annual land gain after only 20 years.

Potential Annual Rates of Land Change over Next 50 Years with $100 Billion Investment



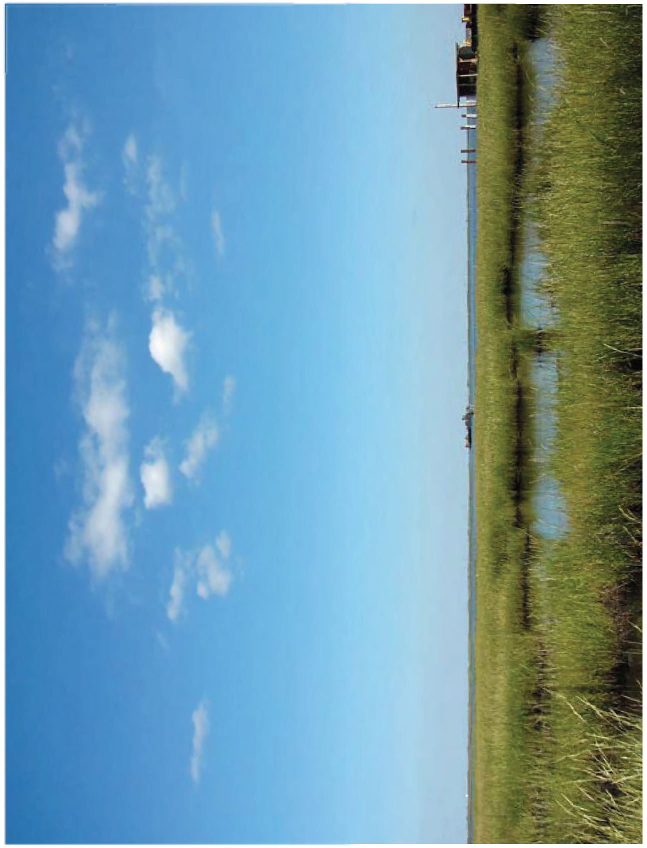
Committed to Our Coast: Creating a Better Future Together

This plan presents a wealth of detail so that readers can be informed about the rigorous analysis we performed. Underneath the complex graphs and tables is a simple purpose—to combat the catastrophe engulfing our state and create a secure future for our citizens. When all is said and done, that is what the master plan is all about. This document traces our analysis, and it is supplemented by appendices that provide further technical detail. Appendices are presented at www.coastalmasterplan.la.gov and are available on CD.

Our analysis confirmed what those in Louisiana already know: our coast and our people are in the midst of a land loss crisis that requires immediate and large scale action. Our analysis revealed good news too: we have tools that can combat land loss and flooding and make a difference for Louisiana citizens and nationally important assets.

Given all that is at stake and all the opportunities we have to make a real difference for our coast, we hope these documents do more than just provide a wealth of information and pictures. We hope that this plan will encourage all of us who live in coastal Louisiana to come together and chart a new future. Change is upon us. We can either embrace it or become victims of the challenges we face.

As we confront these challenges, we know that we must look forward not back, and that we must take advantage of every opportunity to create a sustainable and vibrant coast for our people and businesses. This plan offers a path to reach that goal, one that is informed by local knowledge and supported by world class science.



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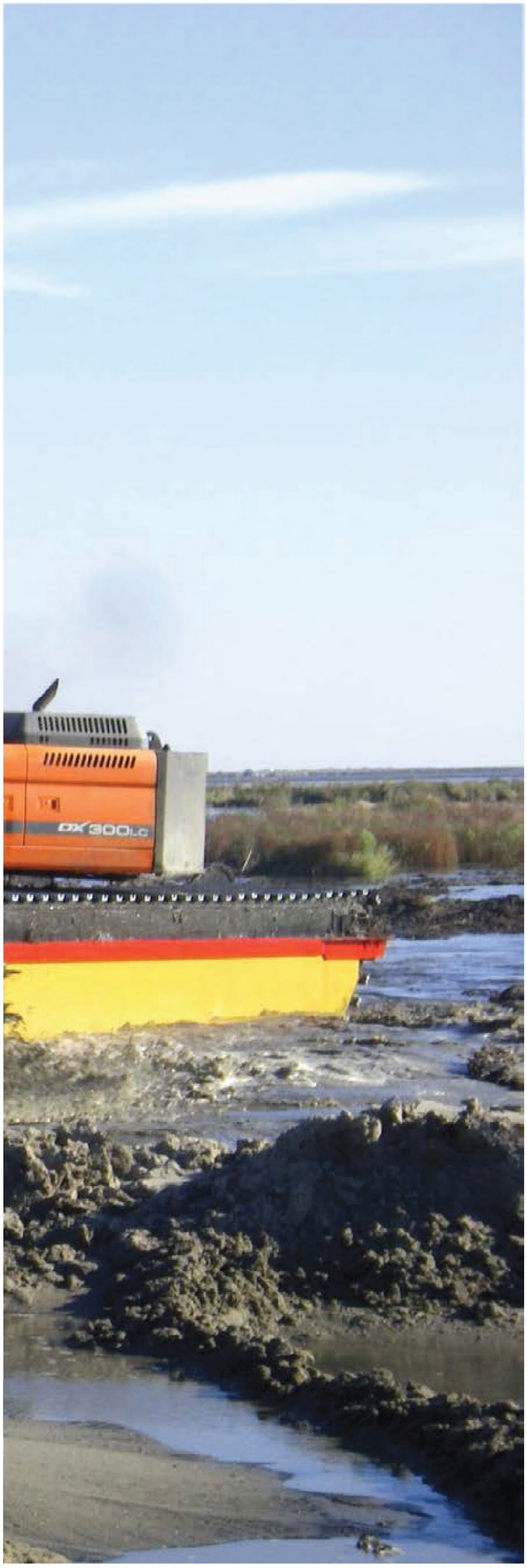


Chapter 1
Guidelines for the Master Plan

Marsh creation at Bayou Dupont.

Guidelines for the Master Plan

Chapter Preview

This chapter explains the guidelines that shaped the 2012 Coastal Master Plan, including the broad planning concepts we used, our public engagement approach, and the technical underpinnings of our analysis.

The 2007 Coastal Master Plan established the foundation for our work, particularly its emphasis on improving protection from storm flooding and creating a sustainable ecosystem. The 2007 master plan's comprehensive approach was reflected in its objectives, principles, and conceptual project ideas. We built on this foundation for the 2012 Coastal Master Plan, but we went one step further and identified specific projects that represent sound investments for Louisiana.

The 2012 Coastal Master Plan was developed using extensive scientific analysis. The master plan also reflects what we have learned in conversations with coastal residents and local leaders. The new plan thus reflects in depth technical inquiry informed by an ongoing conversation with the citizens of Louisiana.

2007 Plan Features that We Carried Forward

- Comprehensive look at how to protect and restore Louisiana's coast
- Use of the Mississippi and Atchafalaya Rivers to address root causes of land loss
- Integration of hurricane protection and ecosystem restoration measures
- Broad concepts and strategies for moving forward
- Improved coastal modeling effort
- Focused objectives
- Stakeholder ideas

What's New in the 2012 Coastal Master Plan

- Detailed assessment of the future if we take no new action
- Expanded portfolio of solutions available to coastal residents through nonstructural protection measures
- Evaluation of hundreds of candidate project ideas
- Use of innovative tools to identify the best projects and the most effective use of dollars
- Large scale solutions that address the root causes of land loss and reduce flooding risk for coastal communities
- Additional guiding objective that reflects the importance of Louisiana's working coast

Master Plan Mission

The 2012 Coastal Master Plan is designed to provide the leadership needed to save our coast.

Comprehensive Scope

The state used a cutting edge technical analysis to think big and evaluate the needs of the entire coast. This analysis has helped us make sound decisions about how funding should be most effectively invested. The resulting plan will deliver results and is fiscally responsible.

Broad Based Collaboration

The plan represents the results of a working collaboration among local, state, and national stakeholders- representing the millions of people who live, work, and play in Louisiana.

Providing for Future Generations

The projects in the plan move us closer to a sustainable coast, one that provides a thriving, resilient landscape for human and natural communities into the future.

To anchor the mission statement in more detail, we oriented our efforts around objectives. Four of these objectives were carried over from the 2007 Coastal Master Plan. A new, fifth objective reflects the special character of Louisiana's working coast.

Master Plan Objectives

The objectives reflect the key issues affecting people in and around Louisiana's coast. The objectives seek to improve flood protection for families and businesses, recreate the natural processes that built Louisiana's delta, and ensure that our coast continues to be both a Sportsman's Paradise and a hub for commerce and industry.

Flood Protection

Reduce economic losses from storm surge based flooding to residential, public, industrial, and commercial infrastructure.

Natural Processes

Promote a sustainable coastal ecosystem by harnessing the natural processes of the system.

Coastal Habitats

Provide habitats suitable to support an array of commercial and recreational activities coast wide.

Cultural Heritage

Sustain the unique cultural heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment.

Working Coast

Promote a viable working coast to support regionally and nationally important businesses and industries.

Master Plan Principles

The following principles serve as guidelines for fulfilling the plan's mission and objectives. They reflect guidance from years of coastal planning work in Louisiana, including principles reflected in the Coast 2050 document, the Louisiana Coastal Area Study, and the 2007 Coastal Master Plan.

Long-term solutions

The 2012 Coastal Master Plan is charged with providing a sustainable long-term solution for coastal protection and restoration. In keeping with this charge, our projects' tangible effects should be of long duration. For planning purposes, projects were evaluated, prioritized, and integrated using a planning horizon of 50 years. Beyond 50 years, uncertainties about sea level rise, project costs, and other factors become too great to maintain reliable evaluation results.

Seeking sustainability

The master plan seeks the long-term sustainability of the coast while recognizing the urgent need for action. A sustainable system is one characterized by consistent levels of productivity and resilience (the ability to withstand naturally variable conditions and/or recover from disturbances). Creating a sustainable system will reduce the long-term costs of projects, both in terms of energy use and operation and maintenance expenses. The plan relies, to the maximum extent possible, on natural cycles and processes. This will be done while keeping limited funding and resource budgets in mind.

Systems approach

The master plan was developed using a systems approach to flood risk reduction and restoration, whereby benefits of actions and the most effective portfolio of solutions were identified.

Clear expectations

Evaluations were made with the understanding that we cannot recreate the coast of the 20th Century. Instead, we must seek to fashion a new landscape that will support viable natural and human communities into the future.

Acknowledging residual risk

The master plan acknowledges that protection systems (both structural and nonstructural) and restored coastal habitats cannot eliminate all flooding risks, and that some degree of residual storm related risk will be inevitable in coastal Louisiana. The plan supports and promotes close coordination among all jurisdictional authorities to minimize the risk of property damage, and inform stakeholders of ongoing residual risk.

Public's role

The master plan acknowledges the leadership that the state and its federal partners must show in defining the path forward. At the same time, achieving a sustainable coast is a collective endeavor. In addition to effective government action, success will require citizens to offer their ideas as planning proceeds and make informed decisions about living and working in south Louisiana. Strong flows of information between agencies and the public are essential to continued progress.

Providing for transitions

Louisiana's coastal crisis is currently displacing resources, infrastructure, and communities. As we address this crisis, sensitivity and fairness must be shown to those whose homes, lands, livelihoods, and ways of life may be affected, in the near-term and long-term, by master plan projects or by continued land loss and flooding.

Participatory process

The master plan was developed with the participation of the many diverse interests that live, work, play, and own property in coastal Louisiana, along with national interests that have a stake in coastal Louisiana's landscape.

Accounting for uncertainties

The master plan considers how both financial and scientific/technical uncertainties influence the selection of projects. Although our protection and restoration efforts must be based on sound and robust science, we must also acknowledge that substantial uncertainties remain, especially with regard to climate change. For example, we do not know with certainty the rate of sea level rise we can expect over the life of a restoration project, nor can we fully predict all ecological responses to actions such as sediment diversions. We do know, however, that dramatic land loss will continue unless we act boldly. In many cases, the risk of doing nothing is far greater than the risk of acting with incomplete knowledge. Thus, we used high-quality science, while recognizing that the quest for perfect knowledge may be both fruitless and ultimately counterproductive. Calculated risks will need to be taken.

Adapting to changing circumstances

To accommodate the dynamic nature of coastal processes, reducing flood risks and the restoration of coastal Louisiana is an evolving process. The master plan should lay the groundwork for an effective monitoring and evaluation process that seeks to reduce scientific and engineering uncertainty, assesses the success of the plan, and supports the adaptive management program. The plan will be revisited regularly, as mandated by legislation, and after exceptional events such as hurricanes. The plan will also be refined as necessary to respond to changing economic, social, environmental, and climatic conditions.

Efficient use of resources

The master plan was developed in a way that acknowledges the need for efficient use of resources, such as funding, fresh water, and sediment. The plan's analysis seeks to capitalize on synergies among projects, resolve overlaps and conflicts, and promote sound management of resources.

Sediment for restoration

At present, limited supplies of, or access to, renewable sediment constrain the restoration efforts we can undertake. As a result, we have also considered dredging options if natural processes do not offer us the sediment we need. The master plan recognizes the need to maximize use of sediment sources outside the system. Possible sources of sediment outside the system include the Mississippi River, the Atchafalaya River, Calcasieu Ship Channel, and areas offshore in the Gulf of Mexico.

Ensuring consistency

Given the emergency facing coastal Louisiana, it is imperative that all government agencies act quickly and in accord with the master plan. Governor Jindal's Executive Order BJ 2008-7 highlights the need for the plan to drive and expedite state action across agencies. The same need applies to the state's partners at the local and federal levels, consistent with their mandates and missions.

Regulatory effects

Revisions to some laws and regulations may be needed to help the state's coastal program achieve its goals. The master plan highlights where such changes may be needed so that local, state, and federal partners are able to act in concert with the plan.

Role of private sector

Because the majority of Louisiana's coast is privately owned, close working relationships with private landowners are essential, not only for their support but to gain from their knowledge about private coastal lands. Since Louisiana's is also a working coast, partnerships with businesses and industries are also required for the success of the coastal program. The support of all of these entities is essential for providing coast wide consistency with the master plan's objectives and outcomes.

Working With Partners

Outreach and Engagement Principles

Scope
Citizens should be given opportunities to learn about and comment on the tools and processes that create the plan and not just the finished plan itself.

Timing
Citizens' comments and ideas should be received, reviewed, and incorporated while the plan is being developed, not after the fact.

Fair hearing
Not every citizen preference can be included in the plan. However, the state can promise that each idea will receive a fair hearing, and that questions will be answered promptly and honestly.

Access
The state must provide a variety of ways for citizens to learn about and participate in the master planning process, including small group gatherings, web offerings, direct communication with local and state government, and public meetings.

When all is said and done, this is a Louisiana plan for Louisiana people. That's why the primary data gathering, modeling, and decision making were done by those who know the coast firsthand. Over 80 Louisiana based experts helped develop the master plan. These specialists ranged from the 60 plus scientists who led our modeling effort and advisory panels, to planners, engineers, and scientists at the Coastal Protection and Restoration Authority, to community members who provided guidance. These are all people who live, work, and raise their families in Louisiana. They know exactly how urgently we need solutions for our coast because they see the land loss and live with the flooding and hurricanes that affect us all.

When we set out to develop the master plan, we used an all hands on deck approach. If an idea that had been tried elsewhere in the country or the world could help us here, we wanted to know about it. We wanted the best scientists in the world to provide this kind of information to us, and the ten members of our Science and Engineering Board (see page 53) did just that. This depth of expertise from throughout the world helped us find the best solutions for our coast.

Because the 2012 Coastal Master Plan captures our resolve to build a strong future for coastal residents, we needed community members and local leaders to help us develop the plan. We gathered their ideas in several ways.

Seeking Ideas from Citizens and Local Leaders

We began our outreach efforts by meeting with 40 state legislators as well as coastal parish officials to gain their perspective about how coastal action affects communities. We also met with community groups throughout the coast, including rotary clubs, advocacy organizations, and school groups. These meetings were particularly important for engaging audiences that have not before been involved in coastal planning. Additional meetings with Louisiana scientists allowed us to exchange ideas about how to protect and restore the coast.

Key Outreach & Engagement Statistics

3 — Open house and public hearings held to receive feedback on draft plan: New Orleans, Houma, and Lake Charles

10 — Regional community meetings held throughout the coast July – September 2011

15 — Meetings with Fisheries, Oil and Gas, and Navigation Focus Groups

16 — Presentations to the CPRA and Governor's Advisory Commission for Coastal Protection, Restoration, and Conservation

60 — Framework Development Team members representing community, industry, federal, state, NGO, and academic organizations

116 — Presentations to civic, business, non-profit, and other professional groups

1,350 — Attendees at regional community meetings and public hearings

2,200 — Public comments received on draft plan

11,000 — People visited the plan website during the public comment period

Community Meetings and Public Hearings

At ten community meetings held between July and September 2011, we learned more about residents' ideas and concerns. Approximately 600 citizens attended these meetings. Both at the meetings and online, a total of 800 citizens took part in an exercise that asked for their views about coastal priorities. The exercise results showed that regardless of where they lived, citizens were particularly concerned about land loss as well as reducing risk from flooding and securing the availability of fresh water. The exercises also revealed citizens' concern for the future of fisheries. We considered these preferences as we developed the master plan. Citizens' exercise results were catalogued and posted on the master plan website, which includes detailed information on our planning process and information about how the public can be involved.

In early January 2012, we hosted three public hearings (New Orleans, Houma, and Lake Charles) to receive comments on the draft plan. Over 750 people attended these meetings, which included a five hour open house that allowed citizens to speak with our staff informally and receive answers to their questions firsthand. Citizens also had the option to enter public comments. After the open house, we gave an overview of the master plan and received oral public comments. We received over 100 formal public comments during the three public hearings. In addition to feedback received at public hearings, our team received over 2,200 comments via email, website, and mail.

A Sample of Groups Consulted*

- Abbeville Rotary
- Association of Levee Boards of Louisiana
- Bayou Grace Community Services
- Bayou Interfaith Shared Community Organizing
- Coastal Conservation Association of Louisiana
- Chenier Plain Committee
- Coast Builder's Coalition
- Iberia Levee District
- Global Green
- Lafourche Chamber of Commerce
- Louisiana Charter Boat Association
- Louisiana Landowners Association
- Louisiana Oyster Task Force
- Greater New Orleans Regional Planning Commission
- Ports Association of Louisiana
- SASSAFRAS
- Southeast Louisiana Flood Protection Authority – East
- South Lafourche Levee District
- United Houma Nation Tribal Council
- Vermilion Rice Growers Association

*Appendix G contains a complete list.

▲ Over 300 people attended the public hearing in New Orleans held in January 2012.

The comments we received showed citizens' passion for and knowledge about the coast. Many comments reflected strong opinions about the projects that the plan should contain. We reviewed and considered each of these comments and worked hard to incorporate these views as we finalized the plan. Project specific comments were evaluated to determine the implications of each change. Policy and implementation related comments will help guide our thinking as we implement master plan projects and programs.

Key themes included opposition to certain restoration measures, inclusion of specific regional projects, support of the use of multiple lines of defense approach to reducing flood risk, and requests for more details on programs recommended in the plan.

We would like to thank all of those who spoke with us or sent us a written comment. Learning about citizens' ideas and concerns was a crucial part of the plan's development, and we sincerely appreciate the time that so many people gave to the process. To review all of the comments received, transcripts of public meetings, and a summary of themes and corresponding responses from the Coastal Protection and Restoration Authority, please see Appendix G.

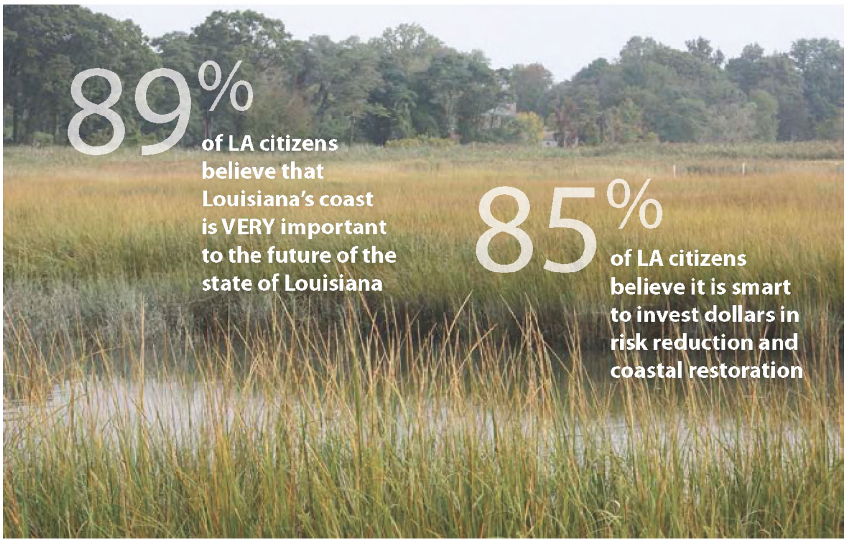
We will continue to work with community members as the master plan is implemented, to ensure that important issues and concerns of coastal communities are heard and incorporated into the process. Collaborating with community stakeholders will help us identify solutions that work best for their unique coastal communities. The addition of a Community Focus Group will not only help the state identify solutions but can increase communities' collective ability to manage future environmental, social, and economic changes.

Coastal Poll

In order to learn even more about Louisiana citizens' knowledge, preferences, and concerns regarding the coast, we conducted a statewide poll. The poll was based on a telephone survey of 1,002 adult residents: 802 residents in the coastal area and 200 residents outside the coastal area. Appendix G provides more information about how the poll was conducted.

Overview of Poll Results

- Eighty-nine percent of Louisiana citizens statewide believe that the coast is very important.
- The jobs and resources generated in south Louisiana drive citizens' views about why the coast is important.
- Citizens strongly believe that it makes sense to invest in protecting and restoring the coast.
- People were not willing to give up on the coast, nor were they willing to write off areas at risk.
- Citizens believe that we know what to do to save coastal Louisiana. They want leaders to get the job done.



Groups That Provided Guidance

In addition to our work with citizens and local leaders, we wanted to receive structured and ongoing advice from key businesses and industries, federal agencies, non-profits, and local organizations as well as coastal scientists and planning experts. We organized several groups to provide this advice. These groups did not formally or informally endorse the master plan, and their participation should not be interpreted as implying such endorsement. Instead, the role of these groups was to provide recommendations and guidance as the plan was developed, so our finished product would reflect broad perspectives and a world class technical approach. Appendix H lists the groups' participants and provides meeting summaries.

Framework Development Team

This group consists of 33 representatives and their alternates from business and industry, federal, state, and local governments, nongovernmental organizations, and coastal institutions. The group is responsible for offering specific guidance to the state on all of the major elements of 2012 Coastal Master Plan. The Framework Development Team works to confront, discuss, and come to a common understanding about the issues that lie at the heart of protecting and restoring Louisiana's coast. Framework Development Team members also reach out to citizens who share their interests, brought these citizens' ideas to the table, and reported back to these citizens about how these ideas were discussed. We met with the Framework Development Team almost every month from June 2010 through March 2012. In addition, ad hoc Framework Development Team workgroups were convened to tackle specific issues, such as river use, sediment, nonstructural protection measures, outreach and engagement, and project modeling. While its membership is subject to change, this group will continue to be engaged going forward, serving as a partner and sounding board for the CPRA as it implements the 2012 Coastal Master Plan.

▲ Logos shown above represent the diversity of organizations represented on the Framework Development Team.

Focus Groups

Large-scale coastal protection and restoration will affect businesses and industry in south Louisiana. In order to integrate the perspectives of those in key business sectors, we created three focus groups each dealing with a key coastal industry: ports and navigation, fisheries, and oil and gas. Leaders in each sector met multiple times with the Coastal Protection and Restoration Authority to discuss in detail the issues facing their industries and explore productive options for the coast. These focus groups were

Science and Engineering Board Members

William Dennison, PhD
(Co-Chair)
University of Maryland Center for Environmental Science

Charles Groat, PhD
(Co-Chair)
University of Texas, Austin

Greg Baecher, PhD
University of Maryland

Edward Barbier, PhD
University of Wyoming

Philip Berke, PhD
University of North Carolina

Virginia Burkett, PhD
United States Geological Survey

Robert Dalrymple, PhD, PE
Johns Hopkins University

Jozef Dijkman, MSc, PE
Dijkman Delft

Katherine Ewel, PhD
University of Florida

Edward Houde, PhD
University of Maryland Center for Environmental Science

Robert Twilley, PhD
(Advisor and Facilitator)
University of Louisiana at Lafayette

instrumental in helping us develop the plan. Based on the strong working relationships forged with these groups as well as comments received, we will also create additional focus groups to support the coastal program. One will address landowner perspectives and concerns; a second will focus on adequately capturing the viewpoints of coastal residents. These groups will begin meeting in 2012, and other focus groups may be created as needed. We look forward to expanding the expertise and partnerships that guide our work.

Science and Engineering Board

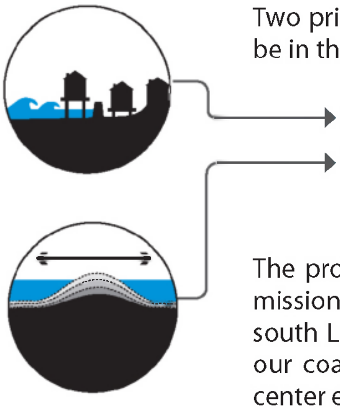
Our Science and Engineering Board was made up of experts with national and international experience. This group provided a high level of input and assessment of the main technical planning components. The Science and Engineering Board participated in five multi-day meetings, as well as 13 webinars. Individual board members worked intensively with the planning team on focused elements of the plan, providing guidance at every juncture of the process.

Technical Advisory Committees

Our Technical Advisory Committees are three to four member groups of nationally known experts who are responsible for advising us on how to conduct our analysis in the most technically sound manner. We have three technical advisory committees: one that assists us with our modeling analysis, one that advises us on our Planning Tool, and one that gives us advice about incorporating cultural heritage appropriately in the plan. Each of these committees has met multiple times with the team to provide in depth feedback. The committees will continue to provide guidance as the master plan is implemented.

▲ The Framework Development Team holds a group discussion.

Decision Drivers



Two primary factors drove our decisions about the projects that should be in the 2012 Coastal Master Plan.

1. **How well did the projects reduce flood risk?**
2. **How well did the projects build new land or sustain the land we already have?**

The prominence we gave these two factors reflected the master plan's mission as affirmed by citizens and local leaders. As anyone who lives in south Louisiana can attest, our communities need flood protection and our coast needs sustainable land. Putting these two factors front and center ensured that the projects we selected addressed the priority needs of the coast.

Flood Risk Reduction

The state would like to provide 100 year protection to all communities and businesses. However, it is not feasible to do so given the inherent risk of living in a hurricane prone area, as well as current funding levels and engineering constraints. We can, however, provide significant risk reduction across the coast, with some type of protection provided for every parish. Just as coastal Louisiana is comprised of several unique landscapes that support particular functions, the type of flood risk reduction projects provided in this plan differs depending on the unique needs and features of specific communities. Our objective is the same coast wide: to reduce economic losses from storm surge based flooding so that we may support the culture, communities, and people of coastal Louisiana.

The 2012 Coastal Master Plan, like its 2007 predecessor, focuses on reducing risk of flooding to properties from hurricane surge and waves. It does not focus on measures that protect against river flooding or measures that protect life and limb. The plan's protection measures were developed using the assumption that people must leave affected areas if human life is to be protected during a severe storm.

Expected Annual Damages

When looking at protection, we had to assess flood risk in a way that was consistent across the coast. To do this, we used what is known as expected annual damages. This concept takes into account that we don't know when floods will occur. Communities may go years without a serious flood, they may experience minor floods, or they may be severely flooded several years in a row—any number of variations is possible.

Our analysis of expected annual damages took a 50 year look at the likelihood of floods occurring and predicted an average amount of flood damages for each community. These averages were expressed as dollars of damage per year. Every community will not flood every year. However, these statistical averages at Year 50 show a given community's likely flood risk and the damage that would be associated with that risk. Having this information allows us to evaluate how risk changes over the master plan's 50 year planning timeframe.

Land Building

This decision driver helps us assess our projects' performance according to an important benchmark: how well our projects build or sustain land. Making this one of our two primary decision drivers helped us keep this crucial benefit front and center as we selected projects for the 2012 Coastal Master Plan. We used a project's ability to build or sustain land, along with cost, to evaluate that project's effectiveness.

We measured land built by evaluating each restoration project's ability to build or sustain land. Our modeling was able to capture the different types of land building that would occur with different project types, such as those described below.

- Marsh creation projects will build most of their land as soon as the project is constructed, and then over time, that land may erode and subside.
- Sediment diversions, in general, do not build substantial land early, but their land building potential continues to grow into the future.
- Barrier island restoration projects will provide land quickly, but waves and currents will redistribute this sediment and nourish adjacent islands. In time, the islands will roll back.

Decision Criteria

Louisianians have different but equally valid ways of viewing what should be done for their coast. To better take this range of preferences into account, we created a set of criteria that represent what is important to coastal residents and business owners. Using these criteria allowed us to consider different ways that risk reduction and restoration projects could affect the coast. Appendix B includes more details about the decision criteria.

Support of Cultural Heritage

This criterion reflects our ability to support the people who live in coastal communities and use ecosystem services/natural resources for work or recreation. The criterion puts a higher value on risk reduction and restoration projects that reduce risk for coastal communities and provide, within a reasonable distance, high levels of traditional natural resources to the people living and working along the coast.

Distribution of Flood Risk Reduction Across Socioeconomic Groups

This criterion reflects concerns about how flood risk reduction is distributed among varying levels of income. The criterion puts a higher value on risk reduction projects that distribute risk reduction across diverse income levels.

Flood Protection of Historic Properties

This criterion puts a higher value on risk reduction projects that reduce the level of flooding for historic properties, which are defined as historic standing structures, historic districts, historic landmarks, and archaeological sites.

Flood Protection of Strategic Assets

This criterion puts a higher value on risk reduction projects that reduce the level of flooding for assets of state or national significance. Strategic assets include critical chemical plants, natural gas facilities, strategic petroleum reserves, power plants, petroleum refineries, ports and terminal districts, airports, military installations and other federal facilities.

Support of Navigation

This decision criterion reflects a risk reduction or restoration project's ability to enhance or impede navigation, both shallow and deep draft, in federally authorized channels. Risk reduction and protection projects can enhance navigation, interrupt navigation, or have no effect at all. This criterion puts a higher value on projects that benefit the navigation industry (e.g., bank stabilization, shoreline protection), while placing a lower value on projects that may impede navigation, such as locks and large sediment diversions.

Support of Oil and Gas

This criterion puts a higher value on collections of risk reduction and restoration projects that improve coastal conditions for oil and gas infrastructure and increase the viability of coastal communities that support the industry.

Use of Natural Processes

This criterion reflects a risk reduction or restoration project's ability to affect natural processes along the coast. Risk reduction and protection projects can enhance natural processes, interrupt them, or not affect them at all. This criterion puts a higher value on projects that use natural processes to advance our goals, such as sediment diversions and oyster reefs. This criterion places a lower value on projects that impede natural processes, such as levees that block natural flows.

Operations and Maintenance

This criterion puts a higher value on restoration projects that cost less to operate and maintain. This value is only calculated for restoration projects. The operations and maintenance costs of protection projects are the responsibility of the local sponsor.

Sustainability

This criterion puts a higher value on restoration projects that keep building or sustaining land 40 to 50 years after they are built.

Ecosystem Services

Ecosystem services are benefits provided to us by nature. In our analysis ecosystem services refer to things like the provision of habitat for natural resources that support fishing and other activities. These services make our coast a Sportsman's Paradise and provide hundreds of thousands of jobs. When developing the master plan, we wanted to understand how implementing projects would affect these services.

An in depth evaluation of ecosystem services would include a dollars and cents component that captures how much these services are worth monetarily. We did not include this economic aspect of ecosystem services in the master plan analysis. Models to analyze this aspect were not readily available, and we did not have enough time to develop them ourselves. Instead, we focused on how a project, or group of projects, might affect characteristics of the coast that provide these services.

Sometimes we were able to directly evaluate changes in an ecosystem service, such as when we analyzed the availability of fresh water for human uses. In other cases, we couldn't directly evaluate an ecosystem service, such as fisheries harvest. In those cases, we used proxies to estimate ecosystem services. Many of these proxies involved evaluating the quality and quantity of habitat to support various fish and wildlife. We could not include all important species in our analysis, so we tried to select those that would represent a cross section. Regardless of whether we directly evaluated a service or used a proxy of the service, we refer to these coastal benefits throughout this document as ecosystem services.

Definitions: Ecosystem Services

Alligator

To predict the effects of restoration projects on alligator habitat, we estimated habitat suitability based on how different combinations of water, vegetation, and land characteristics support alligator habitat.

Crawfish

We developed a crawfish habitat model to predict project effects based on water, land, and vegetation characteristics. The model was not applied to the master plan as it needs additional refinement and testing before it can be incorporated into planning and project analyses.

Storm Surge/Wave Attenuation

We developed a model to reflect the ability of the coastal landscape and restoration projects to reduce the effects of storm surge and waves on coastal communities. The model is based on the location and amount of land in proximity to population centers, type of vegetation, and land elevation. The model was not applied to the master plan as it is undergoing further refinement to better distinguish between the effects of different project types.

Other Coastal Wildlife

To understand the effects of restoration projects on coastal wildlife, other than game species, habitat suitability models for muskrat, river otter, and roseate spoonbill were developed based on water, vegetation, and land characteristics.

Freshwater Fisheries

A habitat suitability model for largemouth bass was used to understand project effects on freshwater fisheries. Water and submerged aquatic vegetation characteristics were utilized in this model.

Oysters

To predict changes in oyster habitat, a habitat suitability model was developed that accounted for land change, water, and bottom characteristics.

Saltwater Fisheries

A habitat suitability model for juvenile speckled trout was used to reflect changes to saltwater fisheries, based on water and vegetation characteristics.

Shrimp

Habitat suitability models were developed for juvenile brown shrimp and juvenile white shrimp to predict changes in habitat based on water and vegetation characteristics.

Waterfowl

A combination of habitat suitability models for mottled duck, gadwall, and green winged teal was used to estimate waterfowl habitat changes based on predicted changes to water, vegetation and land characteristics.

Agriculture

To estimate changes to potential agriculture and aquaculture activities, a model was developed that evaluated salinity characteristics and frequency of flooding in upland areas. This index includes lands that are in production for rice, sugarcane, cattle, farmed crawfish, and other agricultural and aquaculture activities.

Carbon Sequestration

The Wetland Morphology Model was used to estimate project effects on carbon storage potential. Carbon storage varies with the type of wetland, the acreage, and the annual vertical accretion of soil.

Freshwater Availability

A suitability model was developed to evaluate salinities in close proximity to strategic assets or populated areas.

Nature Based Tourism

A model was developed to estimate the potential for nature based tourism. The model measured human access to high quality habitats for wildlife near coastal tourism centers, such as barrier islands and wildlife management areas. The species used to describe this service included: alligator, roseate spoonbill, river otter, muskrat, neotropical migrants, and waterfowl.

Nutrient Uptake

A model was developed to predict project effects on nitrogen removal in open water, sediment, and wetlands.

Using New Tools, Breaking New Ground

Before 2007, separate state agencies were in charge of restoring the coastal ecosystem and providing flood protection for coastal citizens. The 2007 Master Plan brought these two functions together and explored how they could most effectively be combined. Using this foundation, the 2012 Coastal Master Plan identified projects we should construct to provide a sustainable coast. Some of the projects will have large footprints, others will be smaller in scale, but all were selected because they deliver practical benefits for people, businesses, and the environment.

In defining specific solutions, we confronted some real world limitations. There wasn't enough money available to build all of the projects we have identified, and there were limits to the river water and sediment we can use to rebuild the landscape in different locations. In addition, different communities throughout the coast needed and wanted different things. In a time of acute need and restricted budgets, good science and engineering helped us sort through our options and decide which projects should be part of the plan.

In order to select projects that will provide the greatest return on our investments, we used a series of Predictive Models to provide data and a Planning Tool to help us sort through the models' output. The models and Planning Tool helped us better understand how the coast changes over time and how different projects might influence those changes. With this information, we were better able to identify the best coastal investments.

The Predictive Models and Planning Tool are exciting new developments in coastal planning. But it is important to put them in perspective. Our tools did not make decisions for us. They simply informed the choices we made. In addition, our coastal modeling effort is not over. To date, we have used the models to evaluate project and landscape effects for this plan, and we have identified many aspects of this analysis that we want to further develop. We will continue to upgrade our modeling capability and the Planning Tool in coming years, so that we may keep improving our ability to make wise investments in support of a sustainable coast.

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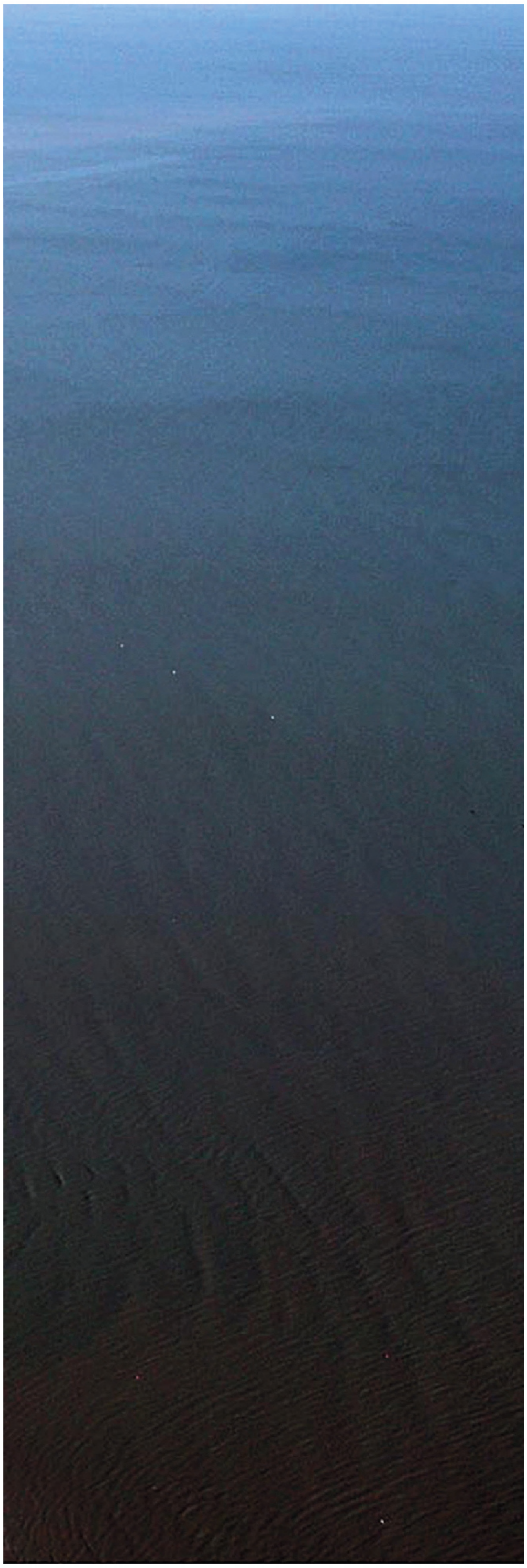


Chapter 2
Identifying Projects

Barrier shoreline restoration along Pass Chaland to Grand Bayou.

Developing Ideas for Analysis

Chapter Preview

This chapter explains the first steps we took in our analysis of projects and how we took stock of the coastal protection and restoration ideas that had come before. This chapter also describes the kinds of projects we examined and how they can help the coast.

We chose the projects in the plan because they offered the most effective and balanced path forward. Before we could identify those projects, however, we had to fully understand all of the options available to us. For this reason, one of our first steps was to take stock of the many project ideas that have been proposed for reducing flood risks and restoring ecosystems in south Louisiana. We created a comprehensive list of these project ideas, learned all we could about them, and used that list as the basis of our analysis. This approach leveraged the countless hours that citizens, scientists, and policy makers have spent over the last decades working on ways to create a sustainable coast. We wanted to build on these ideas and use the hard work and good ideas that had come before.

To develop our comprehensive project list, we mined studies, reports, presentations, and a variety of plans, including local parish plans. Some of these ideas may have been approved by the state or federal agencies for study or design, but none had been funded for construction. Using these sources, we compiled a list of more than 1,500 project ideas. (Projects with construction funding were not included because they already are, or will soon be, a physical part of the landscape.) We recognize that many coastal planning efforts are ongoing and that new project ideas may emerge in the future. Our adaptive management program will examine and integrate these new ideas as we go forward.

Screening the Projects

The 2012 Coastal Master Plan's project list needed to be large enough to represent the breadth of thinking on coastal protection and restoration in Louisiana. At the same time, the list had to be small enough so that every project could be individually evaluated. Given these considerations, we screened the initial list of over 1,500 project ideas to select a more manageable number of candidate projects. Our screening criteria focused on eliminating duplications; ensuring that, as a general rule, projects were at least 500 acres in size; and making sure that every project on the list was described with enough detail that it could be evaluated by our models. We did not screen out projects based on state or stakeholder preferences. For details on the 1,500 projects and the rationale for screening, see Appendix A.

A Consistent Approach to Sediment Diversions

We assembled an initial list of sediment diversion projects that included a variety of ideas. The list was too broad to allow a consistent, comparative analysis of the diversions' effects. With the help of the Framework Development Team's River Use Workgroup, we established locations, discharges, and flow regimes for the diversion projects.

The workgroup members proposed that we consider three maximum discharge capacities: 5,000 cubic feet per second (cfs), 50,000 cfs, and 250,000 cfs, as well as larger scale use of the Mississippi River (i.e., channel realignments) in some locations. Other diversion sizes were also considered in a few cases, where individual projects had already been planned in some detail. The workgroup also defined a consistent operational regime for each diversion.

Sources of Project Ideas

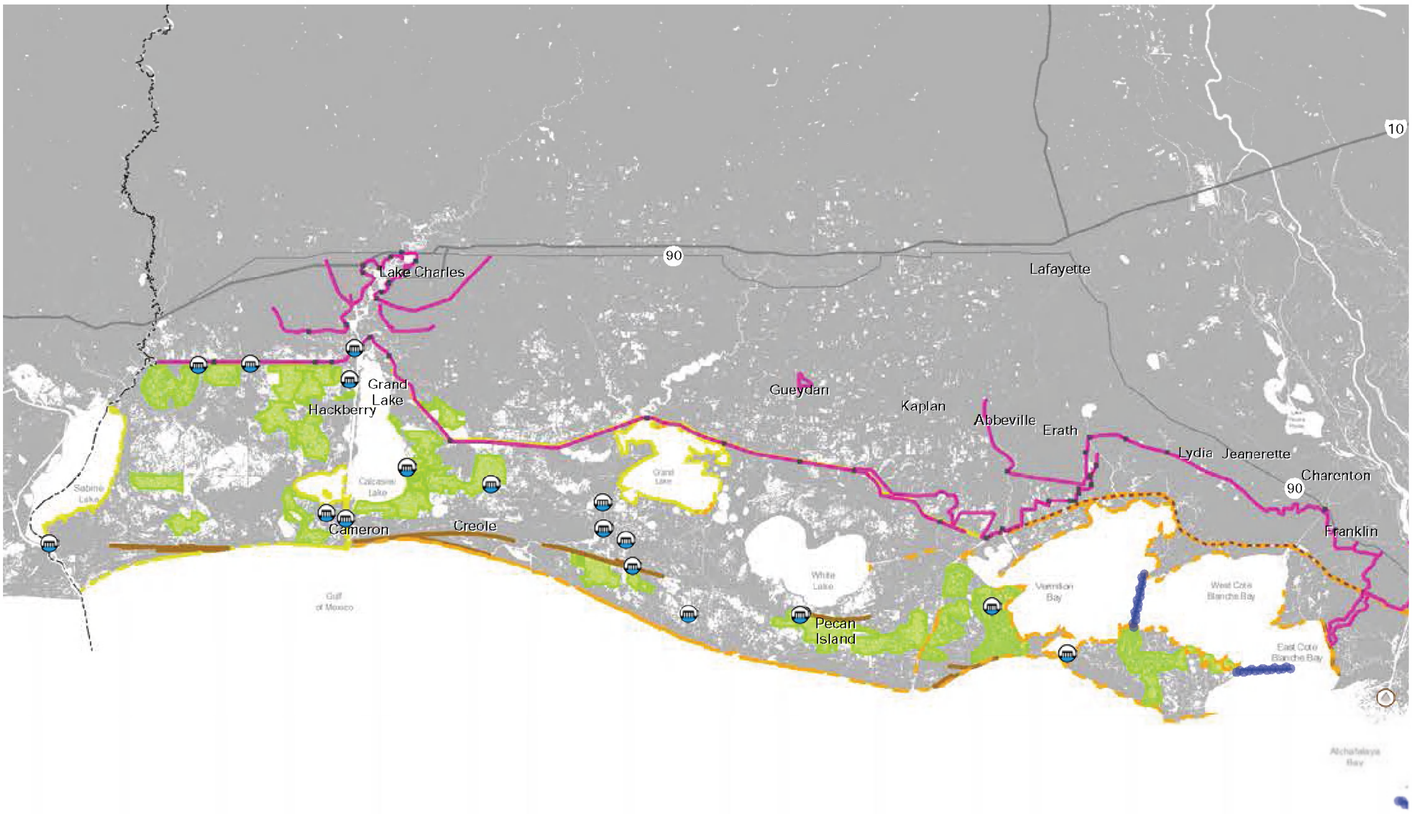
More than 23 large scale studies and planning efforts for coastal Louisiana have been conducted since the 1920s, and they have helped lay the foundation for our work today. In developing the 2012 Coastal Master Plan, we focused on studies produced in the last 15 years. They are listed below.

In addition to the 1,500 project ideas described on the previous page, we developed a list of nonstructural projects coast wide. The following pages provide additional discussion about how we developed this list and the kinds of projects that are included.

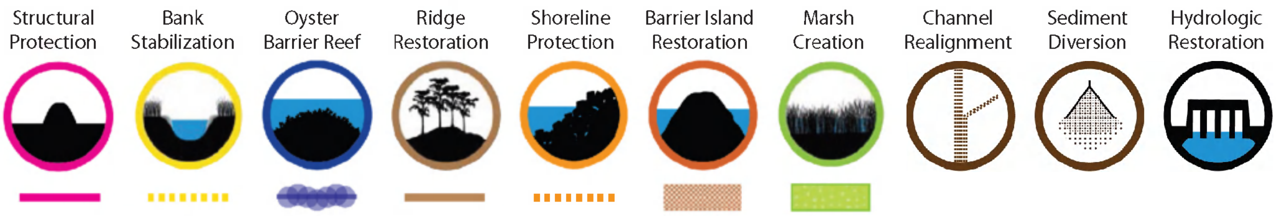
- 2007 CPRA Louisiana Master Plan
- A Dutch Perspective on Coastal Louisiana Flood Risk Reduction and Landscape Stabilization
- A Plan to Sustain Coastal Louisiana Using the Multiple Lines of Defense Strategy
- Barataria Terrebonne National Estuary Program Comprehensive Conservation Management Plan
- Coast 2050: Toward a Sustainable Coastal Louisiana
- Coastal Impact Assistance Program Tier II Projects
- Coastal Sustainability Studio Concepts
- Coastal Wetland Planning, Protection, and Restoration Act Finalists
- Comprehensive Habitat Management Plan For The Lake Pontchartrain Basin
- Envisioning the Future of the Gulf Coast
- Louisiana Coastal Area Comprehensive Study
- Louisiana Coastal Protection and Restoration Final Technical Report
- Mississippi River Gulf Outlet Ecosystem Restoration Study
- Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study
- Parish Master Plans (St. Bernard, Plaquemines, Jefferson, Terrebonne, St. Mary, Vermilion)
- Southwest Coastal Louisiana Feasibility Study
- Third Delta Phase II Reconnaissance Study

Projects Considered

Projects Identified for Analysis as Part of the Master Plan Process



Project Types Included:



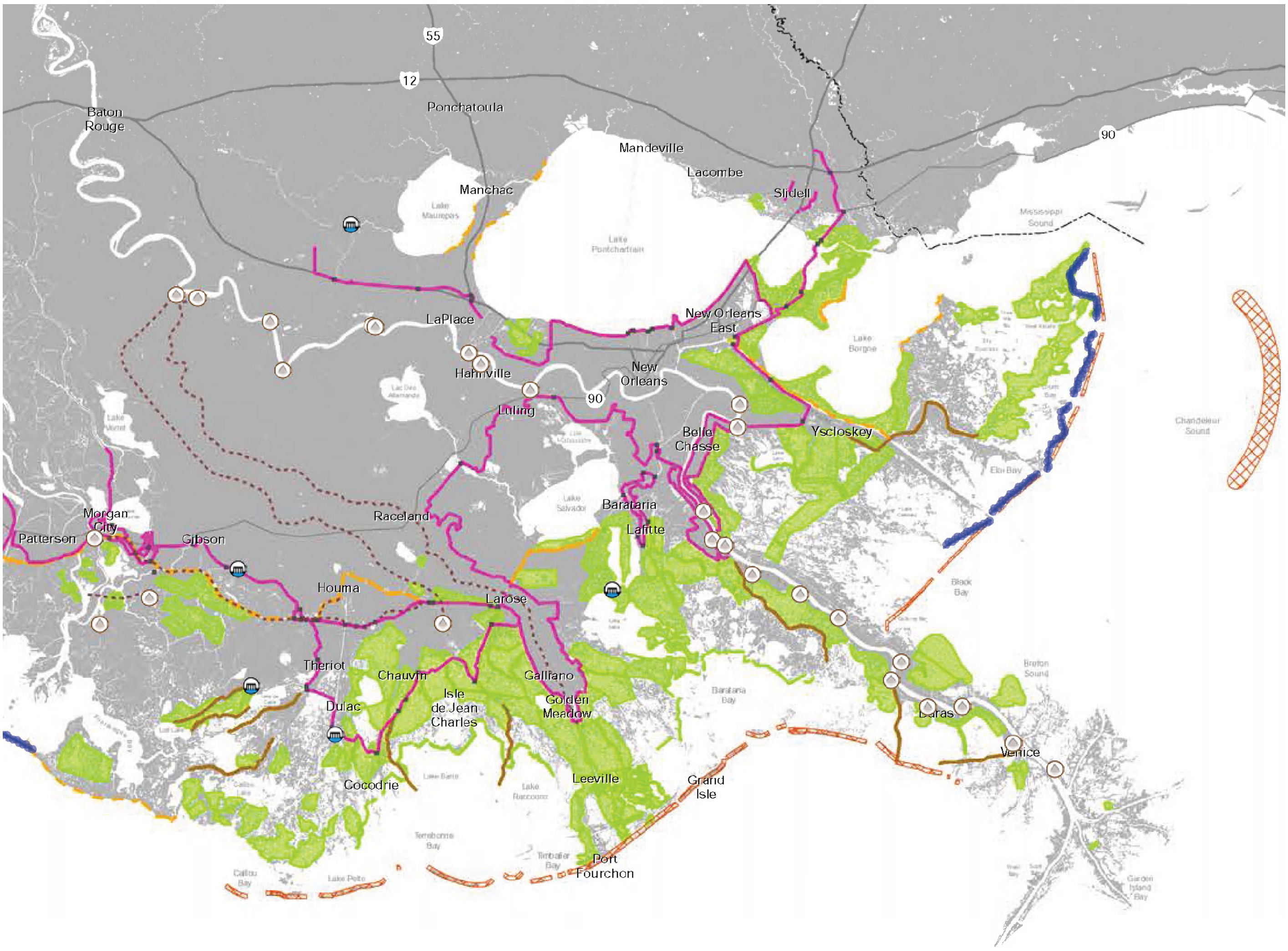
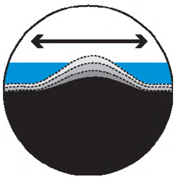


Figure 2.1
Comprehensive list of projects analyzed. Nonstructural protection projects not shown. Not all projects were selected for inclusion in the master plan. Detailed information on all projects can be found in Appendix A.

Types of Projects

Using the process described above, we ultimately developed a list of 397 projects for evaluation in the 2012 Coastal Master Plan. Included within this project list are restoration projects, structural risk reduction projects, such as levees, and nonstructural risk reduction projects, such as elevating homes. Information about all of the projects is provided in Appendix A.



Restoration Projects

The 248 restoration projects on our list can be grouped into the categories below. In addition to helping to build or sustain land, many of these projects contribute to risk reduction, since they may help reduce storm surge.

Barrier Island/Headland Restoration

Creation and restoration of dune, beach, and back barrier marsh to restore or augment Louisiana's offshore barrier islands and headlands.

Hydrologic Restoration

Installation of features that restore natural hydrologic patterns either by conveying fresh water to areas that have been cut off by man-made features or by preventing the intrusion of salt water into fresh areas through man-made channels and eroded wetlands.

Marsh Creation

Creation of new wetlands in open water areas—including bays, ponds, and canals—through sediment dredging and placement. Most projects involve pipeline conveyance of sediment.

Oyster Barrier Reefs

Establishment of bioengineered oyster reefs to improve oyster propagation and serve as breakwaters to attenuate wave energies.

Introduction
1: Guidelines for the Master Plan
2: Identifying Projects
3: Evaluating Projects
4: Developing the Plan
5: 2012 Coastal Master Plan
6: Policies & Programs

Ridge Restoration

Re-establishment of historic ridges in basins through local dredging, sediment placement, and vegetative plantings to restore natural ridge functions.

Sediment Diversion

Use of new channels and/or structures to divert sediment and fresh water from the Mississippi and Atchafalaya Rivers into adjacent basins.

Channel Realignment

Structures and channels that divert all the river water and sediment in the Mississippi River into adjacent basins. Projects would include the dredging of a new navigation channel.

Bank Stabilization

Onshore placement of earthen fill and vegetation plantings designed to reduce wave energies and maintain shorelines in open bays, lakes, and bayous. Bank stabilization projects include work on navigation channels. Given recent federal appellate court decisions regarding navigation channel maintenance, the CPRA has begun an analysis to determine how these important projects should be funded. This analysis will include recommendations for policy change and estimates of associated costs coast wide. For purposes of this plan, we assumed that funding of these projects would be the responsibility of the federal government. When the CPRA codifies its final policy in this matter, we will adjust our project costs and funding strategy as necessary.

Shoreline Protection

Installation of rock or low wave action breakwaters to reduce wave energies on shorelines in open bays, lakes, sounds, and bayous. These projects also include work on navigation channels. For more information about funding navigation channel projects, see above (bank stabilization).

Protection Projects: Structural

Structural risk reduction projects reduce flood risk in coastal communities by acting as physical barriers against storm surge. We viewed protection through the lens of reducing communities' expected flooding risk to either the 50 year, 100 year, or 500 year level. To this end, the 33 structural projects evaluated for the 2012 Coastal Master Plan include one or more of the following basic components:

Earthen Levee

The principal component of structural projects is the earthen levee. These structures consist of pyramidal banks of compacted earth that provide a barrier against storm surge for coastal communities and other assets. Levees can either be linear in shape or ringed. Ring levees form a closed risk reduction system that encircles a protected area, and the protected area is referred to as a polder. Linear levees create a closed system by tying into other linear levees or by extending inland to high ground.

Concrete Wall

These are typically located at points along an earthen levee that have a high potential for erosion or insufficient space for the wide slopes of an earthen levee. Concrete walls were specified at junctions with water crossings, railroads, and major roadways (e.g., interstates and state highways).

Floodgate

Floodgates are needed where levees or concrete walls cross a road or railroad or where they intersect waterways. Floodgates were established for each of these crossings for the structural projects in the master plan.

Pumps

Pumps are needed in enclosed risk reduction systems to allow water that enters a polder to be pumped out. Pumps were included as features of most of our structural protection features.

Protection Projects: Nonstructural

Nonstructural projects raise homes' elevations and floodproof homes and businesses to reduce storm related flood risks. Programs such as land use planning, upgrades to building codes, and public education are also a key part of nonstructural efforts. These programs seek to avoid unwise development and help property owners prepare for flooding.

Many of Louisiana's coastal parishes have already begun to use nonstructural measures to reduce flood risk. In fact, elevating homes has been a necessity in our state's coastal communities for generations. However, there was no comprehensive nonstructural program for us to reference in our analysis. We wanted to fully integrate nonstructural projects into the 2012 Coastal Master Plan and evaluate as many risk reduction project options as possible. To this end, we developed 116 conceptual nonstructural projects for all inhabited areas along the coast. We evaluated these projects along with structural projects when we considered how to reduce flooding risk from 50 year, 100 year, and 500 year storm surge events.

To account for the varying ways in which nonstructural projects may be adopted, as well as the voluntary nature of the program, we analyzed several participation rates. We used a participation rate between 70% and 80%, depending on the nonstructural action considered in the master plan. Also as part of this analysis, we assumed that some areas within levees could benefit from nonstructural measures in the event of storm surge overtopping.

This approach gave us a starting point for understanding how we should fund and implement a coast wide nonstructural program. We did not identify specific projects for individual structures, and the areas associated with nonstructural projects are only roughly delineated. As a result, the 116 projects would not be implemented as discrete projects just as we describe them in this plan. Instead, the projects are a first step toward identifying how much a coast wide nonstructural program might cost and the possible benefits it might have. By the same token, the nonstructural projects in the 2012 Coastal Master Plan do not define specific houses and businesses to be protected, but rather provide a means of evaluating nonstructural projects' contribution to coast wide risk reduction. Because nonstructural options have so much potential for reducing community flood risk, we will add to and refine this program in coming years.

The nonstructural projects we considered used one or more of the measures described on the following pages.

Elevation

This option involves raising residential structures so that their lowest floor is higher than projected flood depths. This measure was considered for areas with a projected flood depth of between 3 and 18 feet.

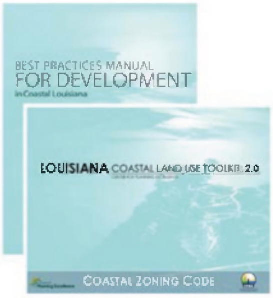
Floodproofing

This option refits structures so they can be resistant to flood damages. Residential and commercial floodproofing was considered for areas with projected flood depths of 3 feet or less.

Voluntary Acquisition

We considered this option in areas where projected flood depths make elevation or floodproofing infeasible and where residential structures would need to be elevated higher than 18 feet. Our initial estimates were that only a small percent of the total nonstructural program would need this option. We will refine this aspect of the program in close partnership with local communities. A community may wish to move as a group to preserve important cultural ties. Other communities may have different needs. Working closely with affected citizens will help us fine tune this component of the nonstructural program.

Nonstructural Programmatic Measures



▲ The Best Practices Manual for Development in Coastal Louisiana and the Louisiana Coastal Land Use Toolkit contain strategies that can reduce flood risk for coastal areas and provide development standards that support wiser growth and progress along the coast.

Land use planning, implementation of ordinances, building codes, and education are among the important ways to protect communities from flooding. Programmatic measures, whether at the state or local levels, shape all nonstructural projects; however, their effect on reducing risk could not be evaluated in our analysis. The Coastal Protection and Restoration Authority and the Center for Planning Excellence have developed resources to provide more information about best practices for managing land in the coastal area. Additional information about nonstructural risk reduction programs, including land use planning, is presented in Appendix F.

In developing the nonstructural projects, we reviewed local, state, and federal hazard mitigation plans to see the types of measures that had been used in the past and how well they performed. We also gathered information on lessons learned through regional stakeholder meetings and discussions with parish governments, the Louisiana Office of Community Development, the U.S. Army Corps of Engineers, and others. Our Framework Development Team had a workgroup dedicated to reviewing our analysis of nonstructural measures and suggesting options for further developing the program.

▲ Land use planning

▲ Building codes

▲ Implementation of ordinances

▲ Education

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Understanding Levels of Risk

What Do 50,100, and 500 Year Protection Levels Mean?

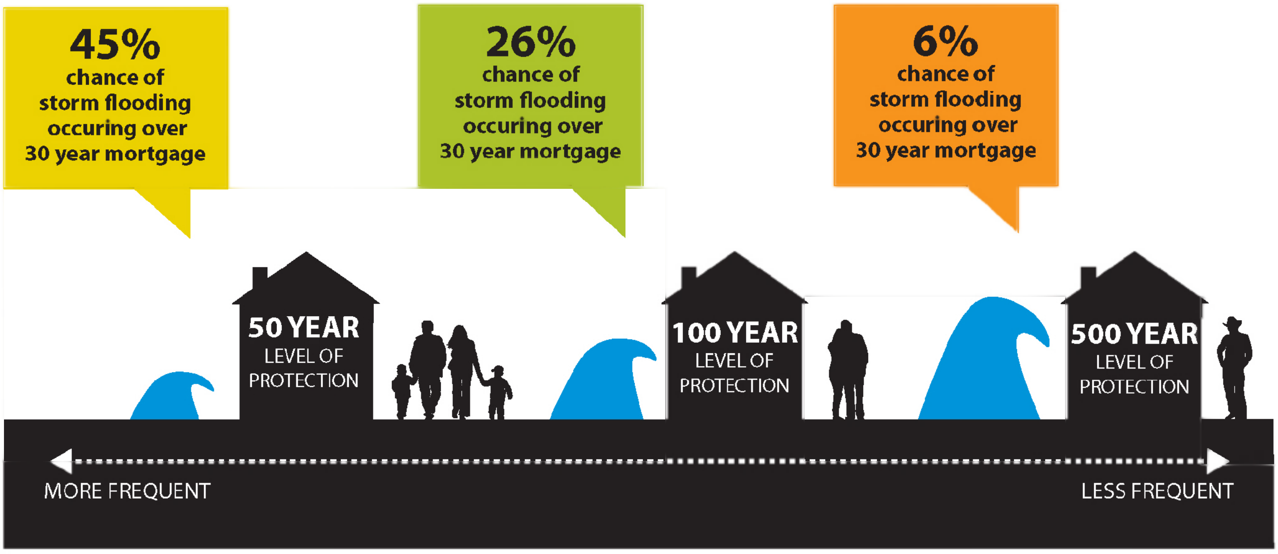


Figure 2.2 The chance of 50, 100, and 500 year flood events affecting a home over the life of a 30 year mortgage.

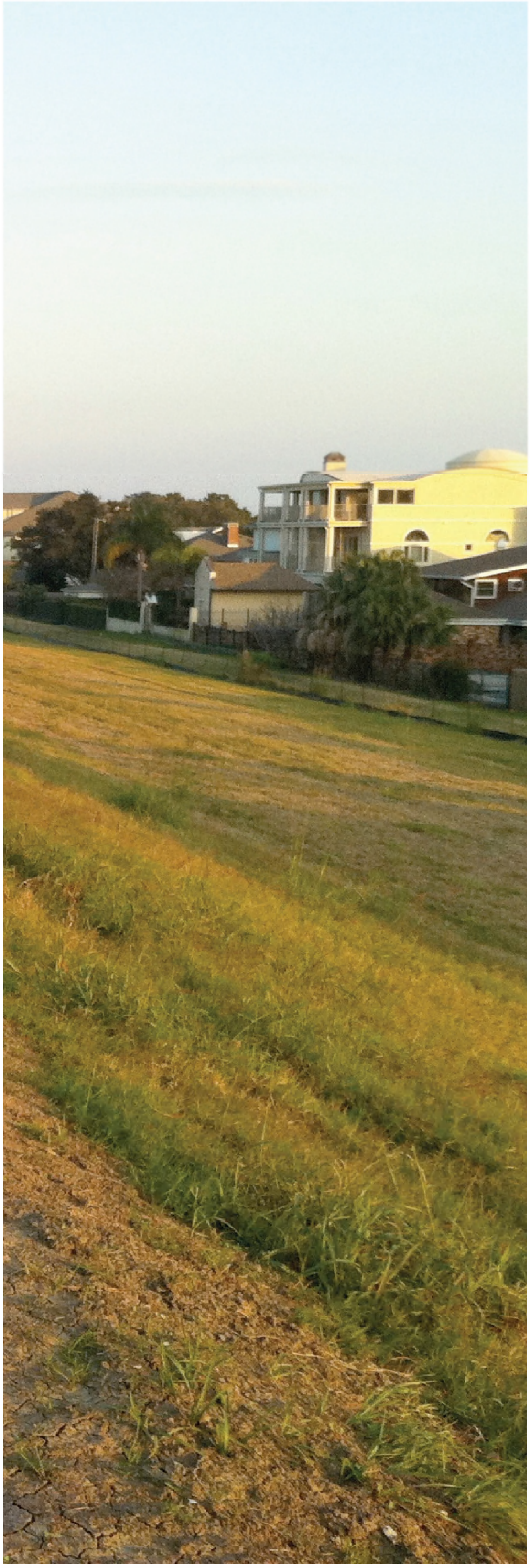
A 50 year level of protection would reduce nearly to zero the damage created by a storm flood event that has a 2% chance of occurring in any given year. A 100 year level of protection would reduce nearly to zero the damage created by a storm flood event that has a 1% chance of occurring in any given year. A 500 year level of protection would reduce nearly to zero the damage created by a storm flood event that has a 0.2% chance of occurring in any given year.

Describing the Projects

We assembled hundreds of project ideas of varying sizes, designs, and budgets. We had to find a consistent way to describe these projects so they could be evaluated on a level playing field. First we identified the kinds of information we wanted to have and established categories for each project type. These categories included different types of information—for example, project location, size, and duration—that when added together would provide complete project profiles. We chose these categories in consultation with our modeling team and other experts since the attribute categories had to mesh with what the Predictive Models and Planning Tool could analyze.

We then began a several month long process to find all of the necessary information specified in these categories. Whenever possible, we took attribute details directly from the original studies that had proposed the projects. Often, however, the studies either did not contain detailed project information or used different assumptions than we did about the projects' life spans and designs. For example, the source studies often used varying elevations for marsh creation projects, and some studies presented projects designed to function for a shorter time than the master plan's 50 year timeframe. In most of those cases, we took the project footprint and applied our own design templates for each project type.

We used a standard system for assigning costs and developing estimates for each category of projects. For construction costs, we estimated construction bid items, unit costs, and quantities. We used historical data to guide us, and we referenced unit costs from recently bid projects in other coastal programs. The final estimated construction cost for projects included contingencies (dollar amounts that allow for expected costs not already identified). Planning, design, and construction management costs were determined as a percentage of the estimated construction cost. Operation and maintenance costs were calculated differently, depending on project type. For projects the state has experience building, such as marsh creation, barrier island restoration, and structural risk reduction projects, operation and maintenance costs were developed to cover specific activities. For project types that have not yet been implemented in coastal Louisiana, such as large scale diversions, operation and maintenance costs were estimated as a percentage of construction cost. The project attributes tables in Appendix A offer standardized information about the project ideas available to protect and restore coastal Louisiana.



Chapter 3
Evaluating Projects

Earthen levee along Lake Pontchartrain.

Evaluating Projects

Chapter Preview

With so many projects to consider, how did we systematically explore our options? This chapter explains how we used technical tools to ground the plan in the best available science. The chapter also explores many of the elements of our analysis, including our methods for assessing sea level rise, subsidence, and other important factors.

Our purpose for the 2012 Coastal Master Plan was to identify projects that improve the lives of coastal residents by creating a more a resilient south Louisiana. Achieving this goal required new tools that helped us better understand our coast and how projects could provide benefits. The coast is a complex system. We needed to better understand how it is changing today and the kinds of changes we can expect in the future. We also had hundreds of project ideas and different views about how to go forward. We needed a way to sort through our many options and find those that would work best for us.

To meet these needs, we used Predictive Models and a Planning Tool. These science based tools helped us understand the practical implications of different project options and how gains in one area might create losses in another. Based on the preferences we wanted to explore, our tools helped identify strategies for investing in coastal protection and restoration projects. This analysis improved our understanding of how projects were affected by constraints: our budget and the river water and sediment that we have to work with. We also used the tools to consider possible future coastal conditions that could affect the way our projects operate, along with other factors such as construction time.

The Predictive Models

The Predictive Models developed for the master plan performed two different functions. First, the models assessed how Louisiana's coastal landscape may change and how much damage communities may face from storm flooding over the next 50 years if we take no further action. Second, the models assessed how the coastal ecosystem and our level of risk could change over 50 years if certain risk reduction and restoration projects are constructed.

The models incorporated what we know about the way the coast works, and they made it easier to identify projects that best achieve our objectives. Most of the models can be run on a desktop computer. Others, especially the storm surge model, can only be run on computer clusters or on supercomputers.

The 2012 Coastal Master Plan analyzed both protection and restoration measures, which influenced the models we selected and how they work. To estimate risk reduction outcomes, we used models that evaluated storm surge and the risk of expected annual damages. To estimate restoration outcomes, the models looked at how land changes throughout the coast—where land is building and where it's disappearing. These models examined how water moves through the coastal system as well as how salt and fresh water affect vegetation and habitats for key species and ecosystem services.

The coast is a complex system. We needed to better understand how it is changing today and the kinds of changes we could expect in the future.

Ecosystem services are benefits that the environment provides to people. In Louisiana, these range from providing the right habitats for oysters and shrimp to nature based tourism. We could not detail the economic aspect of ecosystem services in our analysis. Instead, we focused on proxy characteristics of the coast, such as provision of habitat (i.e. habitat suitability indices) and other factors that can support ecosystem services.

The Predictive Models used in the master plan were organized into seven linked groups, involving the work of over 60 scientists and engineers. Each group worked on a different aspect of how the coastal system changes over time. Our effort was based on existing models where they were appropriate. New models were developed for vegetation, nitrogen uptake, barrier shorelines, flood risk, and to reflect potential for nature based tourism, fresh water availability, and support for agriculture/ aquaculture.

The models were designed to work together, following the precedent set by earlier state planning efforts, such as the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) work conducted for the Louisiana Coastal Area Study. We also found new ways to link the expanded set of models to more fully capture how the coast works as a system. The level of modeling in the 2012 Coastal Master Plan is a significant technical achievement, in the systems approach, the linked nature of the models, and in the breadth of subjects evaluated. See Appendix D for more detail.

Modeling in a Systems Context

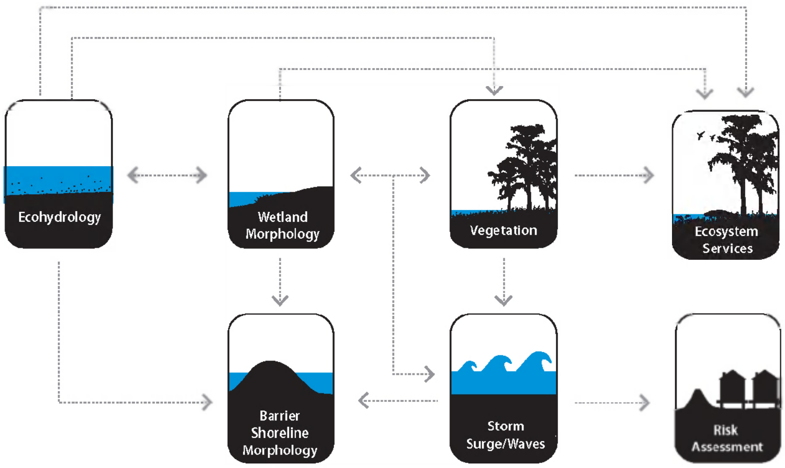
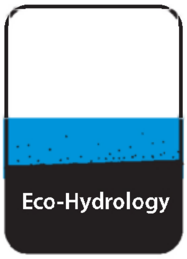


Figure 3.1 The seven predictive model groups used in the master plan and their linkages. For more information about this modeling system, see Appendix D.

Predictive Model Groups

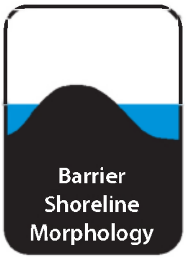


Eco-Hydrology

Predicts changes in water characteristics within estuaries. This group of models predicts water levels, salinity patterns, sediment delivery, and some aspects of water quality. They use output from the Wetland Morphology group to determine the shape and size of open water bodies. Output from the Eco-hydrology model group is used by the Wetland and Barrier Shoreline Morphology, Vegetation, and Ecosystem Services model groups.

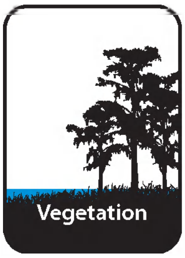
Wetland Morphology

Predicts changes in wetland areas, taking into account the loss of existing wetlands, the creation of wetlands by both natural and mechanical processes, and the fate of those newly created wetlands. This model has been improved over past efforts to consider more factors as predictors of land change. This group of models uses salinity and water level data from the Eco-hydrology group, as well as data from the Vegetation group, and provides information on land configuration to the Storm Surge/Waves, Vegetation, and Ecosystem Services model groups. It also produces outputs that reflect the potential for carbon sequestration in coastal wetlands.



Barrier Shoreline Morphology

Predicts changes in the shape, location, and elevation of barrier islands and the size of tidal inlets over time, including land gains resulting from restoration activities, as well as land loss from wave erosion, sea level rise, and subsidence. It is based on understanding gained from the Barrier Island Comprehensive Monitoring (BICM) program as well as years of other research. It uses inputs from the Wetland Morphology and Eco-hydrology groups to predict the volume of tidal waters moving through inlets. Data on how these inlets change in size is then fed to the Eco-hydrology group. Data on land configuration is fed to the Storm Surge/Waves model group. This is a new model created to support the Coastal Protection and Restoration Authority and the 2012 Coastal Master Plan.



Vegetation

Predicts the location and type of vegetation that will be found throughout the coast, including submerged aquatic vegetation. It provides information about the conditions influencing plant growth, based on newly available data from the Coastwide Reference Monitoring System-Wetlands (CRMS-Wetlands). This model receives input on landscape and water quality characteristics from the Wetland Morphology, Barrier Shoreline Morphology, and Eco-hydrology groups, respectively. The output is used by the Storm Surge/Waves and Ecosystem Services model groups. This is a new model created to support the Coastal Protection and Restoration Authority and the 2012 Coastal Master Plan.

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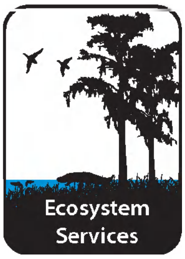
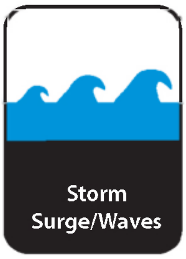
Introduction
1: Guidelines for the Master Plan
2: Identifying Projects
3: Evaluating Projects
4: Developing the Plan
5: 2012 Coastal Master Plan
6: Policies & Programs



Ecosystem Services

Predicts how well Louisiana's future coast will provide habitat for commercially and recreationally important coastal species and habitats for other key services. This group of models uses inputs from all other model groups. It includes habitat suitability indices for American alligator, muskrat, river otter, spotted sea trout, brown shrimp, white shrimp, largemouth bass, gadwall, green-winged teal, mottled duck, neotropical migrants, roseate spoonbill, wild-caught crawfish, and eastern oyster. These species were selected for one or more of the following reasons: they are thriving in coastal Louisiana, they are of commercial or recreational importance, and/or their habitat would likely be either increased or decreased by restoration and protection projects. In addition to habitat models, many of which were based on existing models, new models were developed to reflect potential for storm surge/wave attenuation, nature based tourism, freshwater availability and support for agriculture/aquaculture.



Storm Surge/Waves

Predicts the effects of structural protection (i.e. levees and floodgates) projects on storm surge depth and wave height from hurricanes with a range of size and intensities. This model group uses output from the Wetland and Barrier Shoreline Morphology and Vegetation groups to determine landscape characteristics and provides information on flood depths for use by the Risk Assessment group. This group also evaluates changes in flood depths. This output was used to evaluate nonstructural options and potential support for agriculture.

Risk Assessment

Predicts asset damage that would be caused by storm surge flooding and waves. It estimates the flooding that would result from levee overtopping and/or inundation in areas without structural protection. For enclosed structural protection systems (polders) it also factors in the possible failure of flood protection structures. This model receives input from the Storm Surge/Waves model, and its output is used to estimate the reduction in asset damages that could occur in given locations if a given structural or nonstructural project is implemented. This is a new model created to support the Coastal Protection and Restoration Authority and the 2012 Coastal Master Plan.

Environmental Scenarios

Many factors that will have a profound effect on the future of Louisiana's coast cannot be easily predicted or are outside of our control. These include factors such as subsidence and the levels of nutrients in the river, as well as the effects of climate change, such as sea level rise, changes in rainfall patterns, and storm frequency and intensity. Climate change was central to our analysis, given coastal Louisiana's vulnerability to increased flooding and the sensitivity of its habitats.

To account for these factors when developing the master plan, we worked with experts to develop two different sets of assumptions or scenarios. These scenarios reflect different ways future coastal conditions could affect our ability to achieve protection and build land:

Moderate scenario-

assumed limited changes in the factors on the facing page over the next 50 years.

Less optimistic scenario-

assumed more dramatic changes in these factors over the next 50 years.

Comparison of Predicted Land Change Over the Next 50 Years

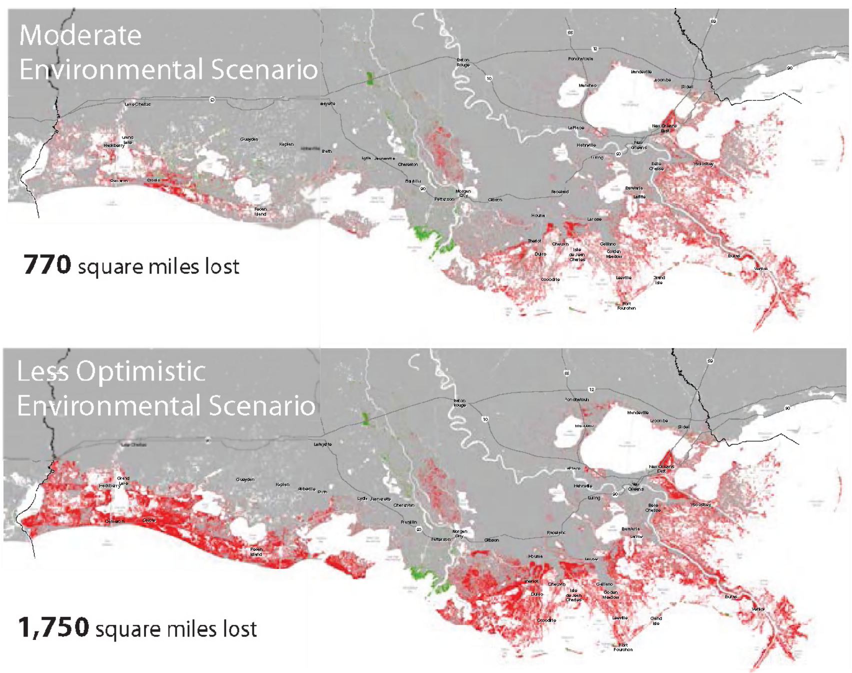


Figure 3.2
A comparison of estimated land change along the Louisiana coast at Year 50 under moderate and less optimistic scenarios of future coastal conditions. Green indicates areas of new land created if we do nothing more than what we have done to date and red indicates land that is likely to be lost.

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Factors	Plausible Range OVER 50 YEARS	Moderate Value CPRA DERIVED	Less Optimistic Value CPRA DERIVED	Range Source
▶ Sea Level Rise	0.12 m to 0.65 m of sea level rise over 50 years	0.27 m of sea level rise over 50 years	0.45 m of sea level rise over 50 years	Literature, USACE guidance
▶ Subsidence (varies spatially)	0 to 35 mm/yr	0 to 19 mm/yr	0 to 25 mm/yr	Expert panel
Storm Intensity	0% to +30%	+ 10% of current storm intensities	+ 20% of current storm intensities	Literature, global model predictions
▶ Storm Frequency	-20% to +10%	Current storm frequency (One Category 3 or greater storm every 19 years)	+ 2.5% of current storm frequency (One Category 3 or greater storm every 18 years)	Literature, global model predictions
▶ River Discharge / Sediment Load	-7% to + 14% (annual mean discharge, adjusted for seasonality)	534,000 cubic feet per second (annual mean)	509,000 cubic feet per second (-5% annual mean)	Literature
▶ River Nutrient Concentration (Nitrogen and Phosphorus)	-45% to +20%	-12% of current concentrations	Current concentrations	EPA reduction target vs. current trajectory
▶ Rainfall (varies spatially)	Historical monthly range	Variable percentage of historical monthly mean	Variable percentage of historical monthly mean	Eco-hydrology Modeling Team
▶ Evapotranspiration (varies spatially)	+/-1 standard deviation of historical monthly range	Mean monthly values of the historical record	+0.4 Standard Deviation from historical mean monthly values	Eco-hydrology Modeling Team
▶ Marsh Collapse Threshold	Swamp salinity: 4-7 ppt Fresh marsh salinity: 6-8 ppt Intermediate marsh inundation: 31-38 cm depth Brackish marsh inundation: 20-26 cm depth Saline marsh inundation:16-23 cm depth	Swamp: 6 ppt Fresh: 7 ppt Intermediate: 34 cm Brackish: 23 cm Saline:21 cm	Swamp: 5 ppt Fresh: 7 ppt Intermediate: 33 cm Brackish: 21 cm Saline: 18 cm	Expert panel

▲ **Figure 3.3** Factors Evaluated Under Environmental Scenarios.

A selection of the factors evaluated in our scenarios is presented on the following pages. For information about all of the factors considered in our analysis, see Appendix C.

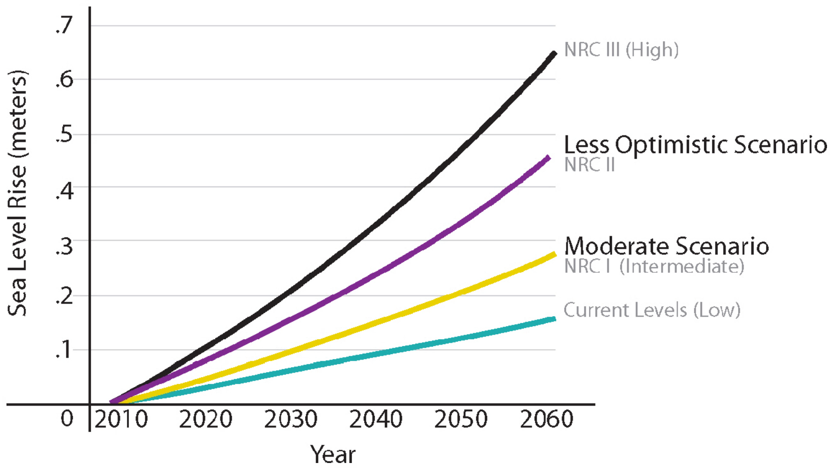
In Depth Look: Environmental Scenarios

Sea Level Rise

When estimating sea level rise for the project level analysis, we based our two scenarios on the scientific literature. The first, moderate scenario assumes an increase in sea level of 0.27 meters (.81 feet) by in the next 50 years. The second, less optimistic scenario assumes a 0.45 meter (1.4 feet) increase in the next 50 years. The Coastal Protection and Restoration Authority's Louisiana Applied Coastal Engineering and Science (LACES) Division recently reviewed the latest science on sea level rise. The LACES analysis shows that the range of sea level rise rates we used in our analysis is within the bounds of current scientific projections of the effects of climate change, including recent estimates from the National Research Council (NRC) and the U.S. Army Corps. However, the latest science released after we began our analysis shows the potential for sea level rise to exceed even our less optimistic scenario. As a result, new rates of sea level rise will be incorporated into future project planning and design.

Estimates of Sea Level Rise over Next 50 Years

Figure 3.4 Scenarios of future eustatic sea level rise based on National Research Council (NRC) and Corps guidance (2011) were used to inform the moderate and less optimistic sea level rise rates over the next 50 years.



Marsh Collapse

In order to predict future land loss or gain in coastal Louisiana, it is necessary to estimate the ability of a given marsh type to persist in response to salinities and inundation. We convened an expert panel to help us determine the best way to address this uncertainty. Based on their recommendation, marsh collapse thresholds were established for fresh, intermediate, brackish, salt and swamp wetlands. Marsh collapse means that the wetland vegetation can no longer persist and the area will rapidly lose elevation (land loss) and convert from wetland to open water.

Subsidence

We convened a panel of locally and nationally acknowledged experts to help us make well grounded predictions of future subsidence trends. Instead of only using historical rates to guide us, we used a range of subsidence estimates. Rates across the moderate and less optimistic scenarios listed above were selected from within these estimates. We are also using different rates of subsidence for different parts of the coast, since rates in west Louisiana differ from those in the east. This approach helped us account for variations in Louisiana's complex geology.

Ranges of Coast Wide Annual Subsidence Rates

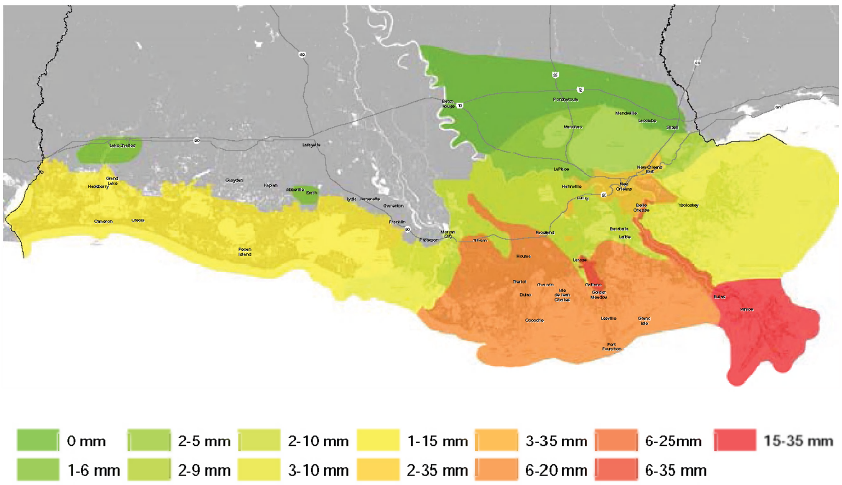
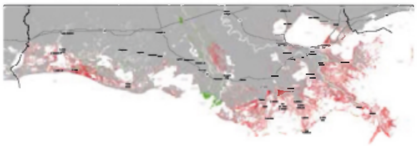


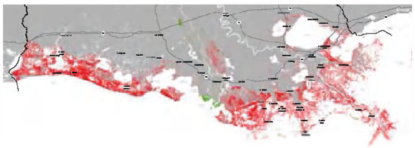
Figure 3.5 Regional ranges of subsidence rates in mm/yr were used as inputs to the modeling analysis. The ranges depict both current values and predicted future values over 50 years.

Assessing the Baseline: The Future Without Action

Moderate Scenario



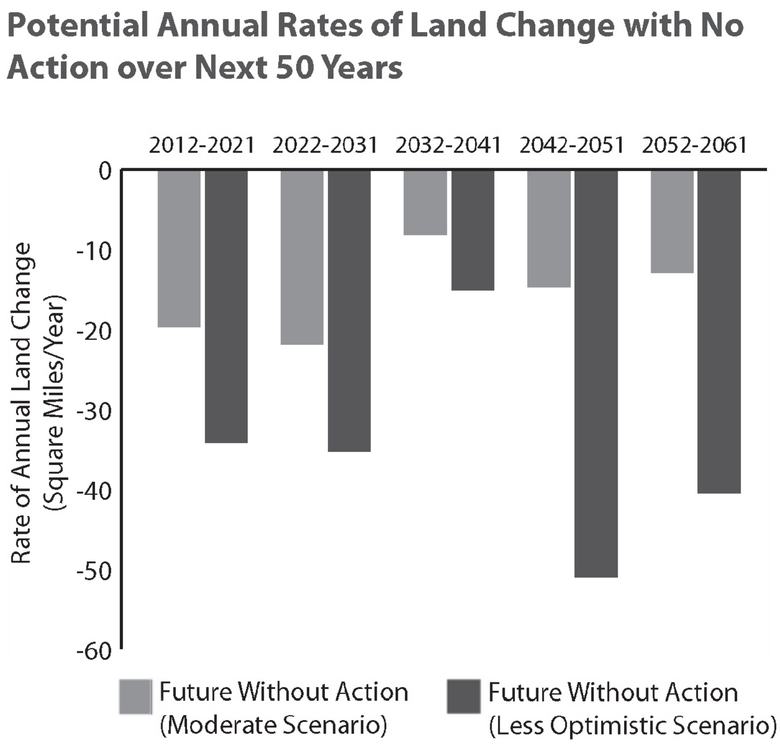
Less Optimistic Scenario



The 2012 Coastal Master Plan presents a 50 year plan for the coast, which required us to estimate the effects of projects decades into the future. Because Louisiana's coast is a dynamic, ever changing system, the conditions 50 years from now will be different from those today. In addition, many projects included in the plan will not be implemented for several years, or even decades, as further design is undertaken and funding is obtained over time. Given these issues, the most accurate way to predict the effects of projects in the master plan is to compare them against the future landscape that would occur without the plan. To capture this comparison, we investigated what we called "Future Without Action" conditions for the next 50 years, meaning conditions that would be present throughout south Louisiana if we do nothing further to protect and restore the coast.

We used the Predictive Models to evaluate how the Future Without Action might look. To inform this effort, the models used the two scenarios of environmental conditions described above: "moderate" and "less optimistic." Appendix C provides more detail about these scenarios.

Figure 3.6 Predicted annual rate of land loss and land gain every 10 years under moderate and less optimistic scenarios of future coastal conditions.



To better estimate Future Without Action conditions, our models included projects that are already constructed, so that we could account for work that we have done to date. We also factored in projects that will be built in the near future because they have received construction funding.

Future Without Action Results

The results below reflect what will happen if we do nothing further to protect communities and restore the ecosystem.

- Under the moderate scenario, our analysis shows that we could lose 770 square miles of land. This amount rises to 1,750 square miles of land loss under the less optimistic scenario of future coastal conditions. See Figure 3.2.
- The rate of land loss varies over the 50 year planning timeframe. Under the moderate scenario, the average annual rate of loss varied from 8 to 22 square miles per year. Under the less optimistic scenario, the land loss rate varied from 15 to 51 square miles per year. This is consistent with the dynamic nature of the coastal landscape and historic land loss variability.
- Flooding to communities will increase substantially by Year 50. Some high risk communities could experience an average of nine feet of additional flooding with a 50 year storm event, resulting in flood depths of up to 15 feet in some communities.
- Some communities targeted for 100 year protection, like Houma, Lafitte, Lockport, Mandeville, or Morgan City, could experience an increase of up to four feet of flooding in a 100 year event by Year 50 under the moderate scenario. Associated flood depths for this event range up to 17 feet.
- A 500 year event today would cause substantial damage across the coast. In the Future Without Action by Year 50, a 500 year event would flood communities that currently do not flood, and some communities could expect up to 26 feet of inundation under the moderate scenario.
- The additional risk of flooding can be calculated as coast wide expected annual damages, which are predicted to increase from $2.4 billion today to $7.7 billion by Year 50 under the moderate scenario.
- If we experience the less optimistic scenario, the average annual flood damages could reach $23.4 billion by Year 50.

Ecosystem services each respond differently to moderate and less optimistic future coastal conditions. Below are some general trends we observed:

- Services such as saltwater fisheries and shrimp increase under both scenarios as salinities increase in the basins and more edge habitat is created through marsh deterioration.
- Species that depend on fresh water or freshwater habitats, such as alligator, waterfowl, and other coastal wildlife showed significant decreases under the moderate and less optimistic scenarios.
- Other ecosystem services, such as freshwater fisheries and nature based tourism, did not exhibit significant changes over time.
- Freshwater availability, carbon sequestration, and nitrogen uptake showed decreases under the moderate and less optimistic scenarios due to a decrease in fresh water and increased land loss.
- Oyster habitat model results show little change over the next 50 years under the moderate scenario but show an increase under the less optimistic scenario due to significantly higher land loss that creates open water for oyster habitat.
- Agriculture is another important ecosystem service, specifically in Southwest Louisiana. Vermilion Parish, for instance, is consistently rated as Louisiana's top three rice producer. The analysis indicates a decline in agricultural lands under the moderate and less optimistic scenarios. This is due to an increase in flood risk in combination with increasing salinities in the basins. The losses vary throughout the coast. Some areas, such as Mermentau Lakes, could experience substantial loss of agricultural land in the Future Without Action.

How the Models Analyzed Projects

Model Work Group Leaders

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Louisiana State University and LSU AgCenter

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Risk Assessment
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RAND Corporation

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United States Geological Survey

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University of Louisiana at Lafayette

Along with the Future Without Action analysis, we also focused on evaluating individual projects. Using the project attributes we developed, the models evaluated the 397 projects on our list, predicting the effects of each project on the coastal system for the next 50 years. This modeling effort took over a year to complete.

During this phase of the analysis, we looked at the effects of individual projects on the coastal system. We were not evaluating multiple projects at the same time to see how the projects within the master plan interacted.

Individual Project Effects Versus Project Interactions

The modeling done for the 2012 Coastal Master Plan made great strides in explaining the effects of risk reduction and restoration projects on the coastal system. However, our analysis focused on capturing individual project effects on the coastal system; we did not fully capture the effects of project interactions in the modeling done for this plan. We modeled individual projects because hundreds of projects have been proposed for the protection and restoration of our coast, and it would be nearly impossible to model all possible combinations of projects. We therefore had to identify the high performing projects on an individual project level before we could attempt to model projects together.

As we formulated the master plan, our working assumption was that the effects of individual projects were additive. Sometimes this resulted in an overestimation of benefits. For instance, multiple small diversions modeled together had a slightly lower land building potential than the same diversions modeled individually and added together. On the risk reduction side, there may have been some overlap between proposed structural and nonstructural projects that are reducing risk in the same areas.

We did perform some limited analysis regarding how projects worked together. This analysis showed that, in some cases, adding up the benefits from individual projects underestimated the benefits of several projects working together. For example, our modeling results showed that by itself, a marsh creation project near Calcasieu Lake did not sustain itself over time. However, when modeled as part of a group of projects that includes hydrologic restoration and salinity control structures, the marsh creation project lasted beyond 50 years. Our modeling also showed that marsh creation projects located near a sediment diversion were more sustainable after 50 years than the marsh creation project alone. The limited analysis we did on these interactions helped inform the selection of projects in the master plan. Future analyses will take a more detailed look at the interactions of these projects, which will help shape improvements to the coastal program.

We also performed only limited analysis on the effects of restoration projects on flood risk reduction. However, the results bore out what many know to be true: restoration projects can significantly reduce storm surge by increasing ground elevations and providing thicker vegetation that slows wave energy. Our analysis showed that some small projects reduced surge over much larger areas than just the projects' footprints themselves.

This analysis of project interactions also showed that when used in tandem with levees, wetlands improved the level of protection provided. Although the degree of protection varied with the size of the storm and the type of restoration project, restoration projects were shown to be effective parts of a large scale flood protection system. These findings provide evidence that the master plan may provide greater risk reduction benefits than we have accounted for. Our findings also confirm the utility of incorporating wetland rebuilding into the design of future levee systems. Fully quantifying the contribution of restoration to flood risk reduction is a priority for future modeling and planning efforts.

The Planning Tool: An Overview

We used the Predictive Models to assess the possible effects of hundreds of projects. The model results, terabytes of data, are the building blocks of the 2012 Coastal Master Plan. We needed a user friendly way to sort and view these results so that we could identify groups of projects to examine in greater detail. Our computer based Planning Tool displayed model output for us so that we could systematically consider many variables, such as project costs, funding, landscape conditions, and stakeholder preferences, to name a few. The tool showed detailed groupings of projects sorted by factors of importance to us as well as stakeholders. It also showed groupings of projects that were estimated to work together to best achieve the state's goals.

The Planning Tool was designed to translate the models' scientific output and show the practical implications of different options. However, the tool did not make decisions. It did not generate simple answers or a sole ranking of projects. Instead, the tool provided information about how groups of projects met one or more of our objectives. Decision making for the plan followed directly from this analysis, as described in Chapter 4. For more information on the Planning Tool, see Appendix E.

▲ The Framework Development Team reviews information from the Planning Tool.

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In Depth Look: Elements of the Analysis

Assessing Risk

▲ Levee failure in New Orleans.

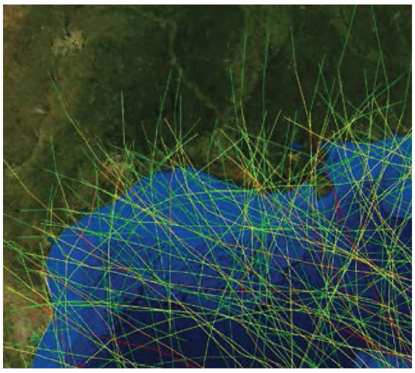
Potential Failure of Levees and Floodwalls

We wanted to better understand the likelihood that storm surge and waves would cause levees and floodwalls to fail. We analyzed three types of failures: overtopping, seepage, and slope stability. Overtopping failure occurs when a storm surge overtops a levee or floodwall and erodes its foundation on the protected side, causing the structure to collapse. Seepage failures occur when enough water flows through the soil under the levee or floodwall to compromise the structure. Slope stability failure occurs when the forces exerted by the floodwater overcome the levee or flood wall's base. By performing hundreds of storm simulations, we were able to identify patterns of when these kinds of failures might occur.

▲ Urban and suburban settlement in the Greater New Orleans area.

Assessing Economic Trends & Demographics

Our assessment of risk from flooding used demographic ranges to account for possible patterns of change in where people live. The risk assessment model assumed an average growth rate that was constant over time based on pre- and post-Katrina rates for each census block and asset class, adjusted for a range of factors. This analysis used data from the 2010 Census and a growth rate of 0.67% per year, which is equal to the annual rate of population growth from 1990 to 2000. Additional information about the risk analysis is available in Appendix D.



▲ Storm tracks in the Gulf of Mexico.

Flood Frequency

To estimate flooding frequency for our risk calculations, we began with a set of 40 storm simulations defined by the Corps of Engineers for the Louisiana Coastal Protection and Restoration Study. The simulations included a range of storm intensities, sizes, and landfall locations. Using these 40 simulations as a starting point, we then broadened our analysis to estimate surge levels for 720 possible storms. These simulations, along with the relative likelihood of each storm occurring, gave us a rough idea of how flooding could occur in Louisiana's coast over the next 50 years.

Setting a Budget

Given that we need to tie our plan to a budget, we evaluated the funding we may be receiving and determined that we could expect between $20 and $50 billion (in present value dollars) over the next 50 years. This is the funding amount that we believe has a good chance of coming to the state from various state and federal sources between now and 2061. For our work on the master plan, therefore, we are estimating that our coastal program will receive between $400 million and $1 billion a year for the next 50 years. Because of the large scale needs of Louisiana's coast, the 2012 Coastal Master plan is based on a budget of $50 billion. This is the upper end of our estimates and better reflects the scope of the challenge facing Louisiana. It is important to emphasize the following:

- These funds are not guaranteed; the funding levels above represent estimates only. If the funds are allocated, they will not arrive all at once, but will instead be spaced over the next 50 years.

- Much of the funding that we are expecting is tied to programs that have been phased in over the past decades: CWPPRA (about $80M per year) and Louisiana Coastal Area (about $150M per year). The Gulf of Mexico Energy and Security Act will also provide about $110M per year. The state may have the opportunity to receive new sources of funding related to the 2010 oil spill. However, the exact amounts and timing of these funds are still very uncertain. The state is also evaluating new potential funding streams that may arise in the future, including credits for carbon and nutrient trading.

- We did not include funding for projects that are a federal responsibility such as MRGO Ecosystem Restoration, federal levees, and navigation channel maintenance.

Possible sources of funds include:

- Gulf of Mexico Energy Security Act
- Energy and Water Act (Corps funding)
- Coastal Wetlands Planning Protection and Restoration Act
- Deepwater Horizon Natural Resources Damage Assessment
- Deepwater Horizon Clean Water Act Penalties
- Carbon and Nutrient Credits
- Future State Funding
- Louisiana's Coastal Protection and Restoration Fund

Estimated Funding For Implementation of the Master Plan Over Next 50 Years

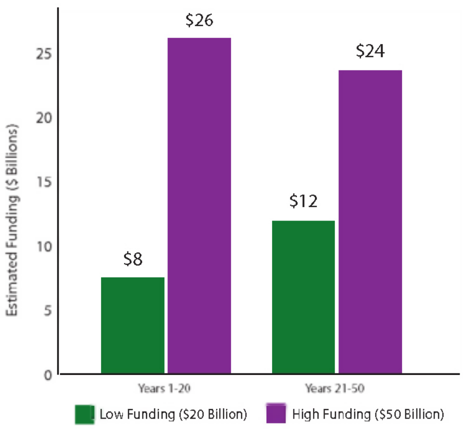


Figure 3.7 Projection of anticipated state and federal funding needed to implement the master plan over the next five decades.

In Depth Look: Elements of the Analysis

Issues Not Addressed in Our Analysis

Many factors that influence the coast could not be addressed in the master plan due to the scale of our analysis and the level of information available. Improving our technical capabilities will be an ongoing task, and we acknowledge the limitations below as preparation for improvements to our planning, design, and implementation processes.

The Predictive Models developed for the master plan are broad planning level models, not design level models. Their assessments of how the coast will change are meant to apply coast wide for 50 years. The models do not predict exactly how small, localized areas will look. In other words, the models predict effects at the large community scale; they don't show what areas the size of individual backyards could look like in the future.

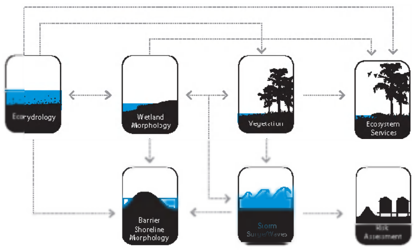
In addition, technical limitations restricted what the models could capture. For example, some of the ecosystem services models were used to estimate the effects of projects on fisheries habitat. While the models were able to capture a project's effects on habitat for a given species, they were not able to capture the project's effect on access to this habitat. A hydrologic restoration project could conceivably improve habitat for shrimp in a given area while providing no mechanism for shrimp to reach the improved habitat.

Similarly, hurricanes may severely damage coastal marshes through surge and wave action, but they also introduce sediment into these marshes. This sediment can assist with land building. The models captured sediment introduction because those trends have been estimated over regions based on past research. However, the destructive effects of hurricanes on marsh, otherwise known as marsh tearing, could not be captured because these effects are usually localized, highly variable, and storm dependent. We discussed this limitation with our Predictive Modeling Technical Advisory Committee and our Science and Engineering Board. They agreed that there was not a readily available solution, since the models cannot predict the paths of future storms. The modeling teams will continue to explore this and other issues, expanding our capability as new data and technologies emerge.

Quality Review & Evaluation of Tools

As part of analyzing projects for the 2012 Coastal Master Plan, we developed and ran new computer based tools with many complex interconnections. We also compiled information about the attributes of hundreds of risk reduction and restoration projects. Since the results of the master plan analysis will guide Louisiana's coastal investments for decades, it was essential that we undertake a rigorous quality review of our tools and data.

The Predictive Models



Many of the Predictive Models used for the 2012 Coastal Master Plan had been developed before our effort began or were based on existing, published models. However, linking some of the newer models was a first for Louisiana. Each group of models was handled by a separate modeling team under the guidance of a workgroup leader. Workgroup leaders were responsible for conducting a quality review of all input datasets used by their team as well as the output generated by their assigned models. Several modeling teams also established a set of external reviewers to provide feedback on model logic and calculations. Review team members and procedures are presented in Appendix D. To facilitate file handling and use, we used a standardized file naming convention, and file acquisition was automated when possible.

In addition to the review teams, a Predictive Models Technical Advisory Committee met monthly while the models were being developed and run. This committee provided guidance on model assumptions, inputs, and other technical details. The Science and Engineering Board also provided broad evaluations of the modeling effort's overall direction. Members of these groups are listed in Appendix H and on our website: www.coastalmasterplan.la.gov.

We have cross checked our models through various technical review teams and are in the process of conducting an analysis of model uncertainty. When this analysis is complete, we will have a thorough understanding of the strengths and weaknesses of the models in the analysis. This will also refine our understanding of how the assumptions in the models affect our results.

In addition the state will begin validation of the Predictive Models according to the U.S. Army Corps of Engineers Planning Model Certification procedure. Besides giving the state a useful quality check, this procedure will ensure that the 2012 Coastal Master Plan models pass muster with the Corps and can be used in tandem with the Corps's own planning efforts.

The Planning Tool

As part of the Planning Tool development there was a rigorous quality assurance process whereby the tool's approach and computations underwent internal peer review by technical experts. In addition, the Planning Tool Technical Advisory Committee that focuses exclusively on the tool met quarterly with the project team.

Chapter 4
Developing the Plan

Restoration project at Goose Point.

Evaluating Project Options

Chapter Preview

As we sought to identify the best performing projects for the master plan, we had an enormous amount of technical information to draw from. This chapter traces the process we used to incorporate this information into our decision making. A list of decision points at the end of the chapter summarizes how we used science and public input to create a plan that is science based and has widespread support.

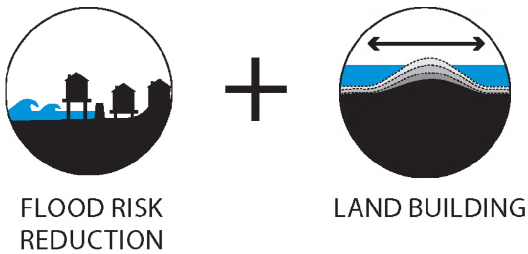
With the analysis of the Future Without Action condition and the results of individual project modeling in hand, we were ready to consider which projects should be included in the 2012 Coastal Master Plan. The challenge? We had hundreds of projects to consider and seemingly unlimited ways to combine them. To begin sorting through our options, we assembled projects into groups that could be implemented over time to meet the master plan's objectives.

We assembled and evaluated hundreds of groups of projects. The Planning Tool helped us do this quickly; we set the parameters and the tool scanned the projects, selecting those that met our specifications. The tool did this by examining the terabytes of data created by the Predictive Models and putting this output in a form we could easily view and analyze. The specifications we used and the lessons we learned from considering these many projects are described below.

Decision Drivers

As anyone who lives in south Louisiana can attest, our communities need flood protection and our coast needs sustainable land. Therefore, in order to be included in the plan, projects had to perform well in at least one of the two areas: (1) making significant reductions in community flood risk, or (2) building land effectively, including sustaining land that would otherwise be lost. Putting these two factors front and center ensured that the projects we selected addressed the priority needs of the coast.

To represent these drivers, we used the Planning Tool to assemble two groups of projects: one that maximized risk reduction (Max Risk Reduction) and one that maximized land building (Max Land). These groups were assembled without considering any other preferences. As clear cut examples of how to achieve our primary decision drivers, these groups of projects were benchmarks for considering other project options.



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Funding

As we began examining projects, we had to decide how the state's coastal budget should be allocated between risk reduction and restoration projects. To inform this decision, we used the Planning Tool to view the results that could be expected from different funding splits. We found that we could not achieve substantially more flood protection benefits by spending more than half of our available funding on risk reduction. We also found that the lines between protection and restoration projects could be blurred, because many restoration projects also reduced flooding risk. This was a common theme of public comments, with many residents asking for the inclusion of additional restoration projects—the Cameron Shoreline, the Biloxi Marsh oyster reefs, and marsh creation for eastern Terrebonne—because of the projects' risk reduction potential.

Taking the data and public input into account, we decided to take a balanced approach to funding restoration and protection projects. Year to year we may spend more than half of our funds on either protection or restoration based on the types of funding we receive and their authorized purposes. However, we will work toward achieving an overall balance over the 50 year planning timeframe.

Although our funding analysis showed that Louisiana could receive anywhere between $20 and $50 billion over the next 50 years for coastal protection and restoration, we used the top end of this range to constrain our selection of projects. We did this because we found that the lower end of the funding range did not provide the resources needed to significantly reduce coastal land loss, nor did it adequately reduce storm surge flood risk. The amount of $50 billion thus became the budget used in our analysis. If future opportunities result in greater funding for our coast, we will welcome the additional investment. Our goal is to secure the necessary funding to protect and restore our coast so that we are doing as much as we can as quickly as we can.

Near Term and Long Term Benefits

Once we decided to use a $50 billion budget and a balanced funding split, we then needed to consider another factor for restoration: how quickly should projects deliver results? For example, some projects build land almost immediately, but this land may degrade with time. Other projects take longer to start building land, but once they do, the land continues to grow. Was it better to put a premium on getting results more quickly (within 20 years), even if these results wouldn't last as long? Or was it more important to invest in projects that might take more than 20 years to deliver benefits but would continue providing value beyond our 50 year planning timeframe? We used the Planning Tool to review our project list and show us the results that could be expected if we put more or less importance on near and long term options. We reviewed various combinations, from a primarily near term focus (90/10) to a primarily long term focus (10/90).

Using an approach that invested equally in near term and long term projects (50/50), land building potential at the end of 50 years was less than 20 square miles different than our Max Land project group. At the end of Year 50, the trajectory of land building was positive, indicating that many of the projects selected will continue to build land past the 50 year analysis period. We decided to pursue this approach because it balanced our need to respond quickly without compromising our long term effectiveness. Investing equally in near and long term projects will provide the land building that is urgently needed today, while also providing benefits for future generations.

On the protection side, risk reduction projects, once constructed, are designed to sustain their benefits throughout the master plan's 50 year planning timeframe. For instance, a levee constructed in the near term would be maintained at the necessary elevation to provide benefits in the long term. Therefore, near term versus long term performance did not affect our selection of risk reduction projects.

Selecting Projects for an Uncertain Future

In order to set a standard of comparison when evaluating groups of projects, we selected a group of projects that maximized risk reduction (Max Risk Reduction) as well as a group of projects that maximized land building (Max Land). These Max Risk Reduction and Max Land project groups kept our analysis focused on our two primary decision drivers: protecting communities and building land. Using these two groups of projects as a foundation allowed us to benchmark the greatest possible benefits with the projects and funding available.

Part of identifying our Max project groups involved seeing how project group performance changed with shifts in future coastal conditions. To capture this aspect, we evaluated candidates for the Max project groups under both the moderate and the less optimistic scenarios. The selection of Max Risk Reduction projects did not vary greatly between the moderate scenario and the less optimistic scenario. However, the choice of Max Land projects was significantly influenced by the scenarios. Heeding the adage, "Hope for the best but plan for the worst," we used the less optimistic scenario as our base for the Max Land project group. Our analysis showed that doing so gave us projects that performed reasonably well under moderate conditions and very well under less optimistic conditions.

We also found that restoration projects built at the upper end of our estuaries, closer to existing land, were much more robust in the face of worsening future coastal conditions than projects built closer to the gulf. This finding is one of the important outcomes of our evaluation and influenced our selection of projects for the master plan.

Decision Criteria

Louisianans have different but equally valid ways of viewing what should be done for their coast. We used the Planning Tool to evaluate how some of these preferences could change the selection of projects in the Max Risk Reduction/Max Land project groups. For example, we conducted an experiment that required the decision criterion "support of navigation" to be considered in conjunction with the Max project groups. This meant that we evaluated a group of projects that would reduce storm flooding risk and build coastal land while also taking navigation concerns into account. We performed similar experiments with a variety of decision criteria combinations. The results of those experiments helped us understand the pros and cons of different approaches for minimizing flood risk and building land.

As we went through this process, we found some general patterns among the decision criteria. All of these experiments were viewed relative to our Max Risk Reduction and Max Land project groups, recognizing that imposing any preferences on these drivers would decrease the amount of risk reduction provided and/or land built.

When we used the Planning Tool to factor in a preference for the decision criteria below, our Max Risk Reduction and Max Land project groups did not change. In the cases below, we could not stipulate an increased preference for these decision criteria because the Max project group already achieved the maximum possible level of that preference.

- Distribution of Risk Across Socioeconomic Groups
- Flood Protection of Historic Properties
- Flood Protection of Strategic Assets
- Operation and Maintenance Costs

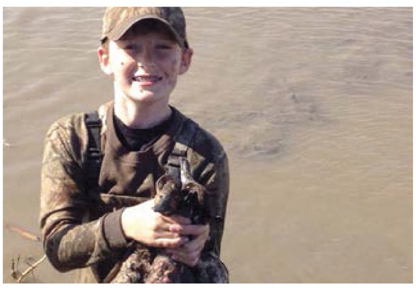
In other cases, we found that as we increased the preference for a specific decision criterion, we saw a significant decline in risk reduction or land building potential. We were able to identify the point at which we could increase the preference without unduly affecting the outcomes achieved by our Max project groups. We used this information to modify the selection of projects. The decision criteria that we used in this way were:

- Use of Natural Processes
- Support of Navigation
- Sustainability

Other decision criteria could only be evaluated after we selected groups of protection and restoration projects. The decision criteria below were evaluated to ensure that we didn't select a group of projects for the plan that would have drastic negative impacts in these areas of interest:


- Support for Cultural Heritage
- Support for Oil and Gas

Overall, we found that many of the same projects were selected regardless of which decision criteria we focused on. This helped us hone in on projects that met the needs and preferences of many coastal users while supporting our decision drivers. Selected projects that have negative implications for certain preferences, particularly those that are conceptual in nature, may be explored further through the Adaptive Management Framework to minimize impacts.



Ecosystem Services

We refer to the variety of benefits the coast provides as ecosystem services. For the purposes of this plan, we evaluated the outcomes of habitat suitability indices and other variables. This gave us an idea of how projects might affect associated services.

Not only did we evaluate an individual project's effect on ecosystem services, we looked at the collective coast wide effect of groups of projects on those services. Our aim in doing so was to ensure that the projects we selected did not cause drastic reductions to ecosystem services coast wide. This approach was in keeping with the master plan objective that seeks to support a wide array of activities in coastal Louisiana.

Projects affected services in different ways in different areas of the coast. Although we were able to capture general trends in ecosystem service levels, the inter-relationships were complex. This analysis used large scale planning level models to provide output about general trends and project effects. These system models did not provide site specific details needed for project design. We recognize the need for continued investment in analytic tools that improve our ability to assess changing coastal conditions and take into account the fine scale human use and economic effects of projects.

Despite the limits of our analysis, we were able to discern large patterns of how services are affected, and this helped us more thoroughly evaluate different groups of projects.

In Depth Look: Land Building

Use of Diversions

Our analysis indicates that sediment diversions, potentially including channel realignment, are essential to sustaining coastal Louisiana. The overwhelming majority of scientific literature on the subject comes to the same conclusion. We understand that viewpoints regarding diversions vary among coastal residents. Some people want several large diversions so that the state can build significant amounts of coastal land. Others believe that the state should use other strategies besides diversions. Still others support the idea of diversions but fear that if diversions are put in the wrong place or operated in the wrong way, the projects will harm important industries such as oyster farming.

One lesson learned from previous experience is that future diversions should focus on sediment capture and land building. As such, the 2012 Coastal Master Plan focused on sediment diversions and not on the use of freshwater diversions as a restoration tool. Our tools evaluated sediment diversions to maximize land building, using a 20 year river flow record of the Mississippi River. We modeled large scale diversions as operating at maximum capacity (250,000 cubic feet per second) only when the river flow was above 900,000 cubic feet per second. Using this constraint, large scale diversions flowed at full capacity only 15% of the time and never operated at full capacity between August and November. For 14 of the 50 years modeled, the large scale diversions did not reach full capacity at all. As these projects are further developed, their operation will continue to balance maximal land building with the need to sustain our saltwater dependent coastal resources. During project design, more detailed modeling efforts and additional coordination with key stakeholders will help us further define operational regimes.

No Diversions

We conducted an experiment to maximize land building without the use of diversions or channel realignments. This involved selecting the best group of projects that builds land mechanically. When we compared the effects of these projects on species based ecosystem services, we found that the projects caused very little change in the level of ecosystem service provided compared to Future Without Action conditions. However, this approach cut our land building potential by 340 (moderate scenario) to 630 square miles (less optimistic scenario), thus decreasing our total land gain by half compared to results predicted for the Max Land project group. In addition, we continued to experience annual land loss at Year 50 ranging from -3.3 square miles/year to -24 square miles/year depending on future coastal conditions. These results indicate that sustainable restoration of our coast without sediment diversions is not possible.

Potential Land Area Change Over Next 50 Years
Moderate Scenario

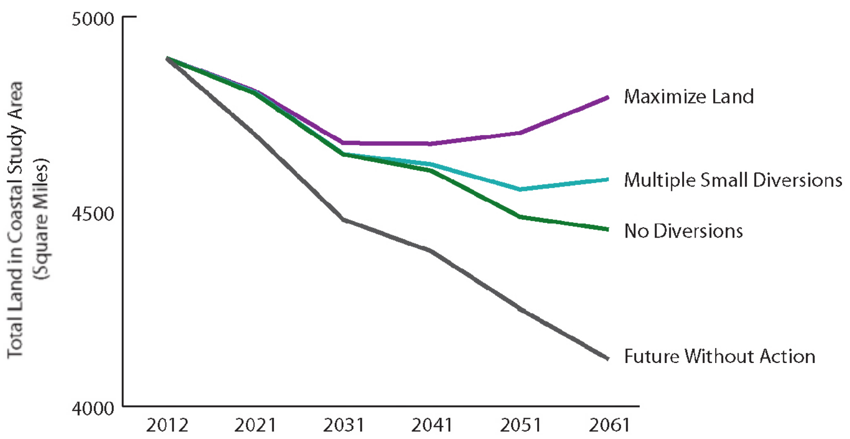


Figure 4.1 Comparison of land changes in the coastal study area using different restoration strategies under the moderate scenario. Future Without Action is depicted for comparison purposes.

Potential Land Area Change Over Next 50 Years
Less Optimistic Scenario

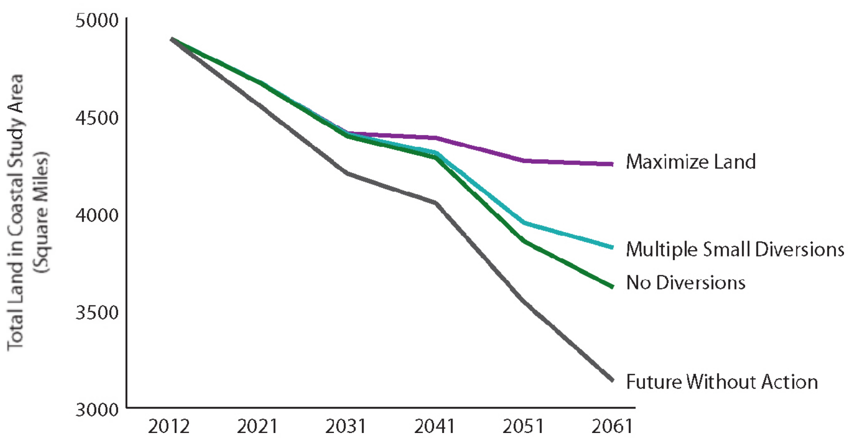


Figure 4.2 Comparison of land changes in the coastal study area using different restoration strategies under the less optimistic scenario. Future Without Action is depicted for comparison purposes.

In Depth Look: Land Building

Multiple Small Diversions

We explored the land building and ecosystem service effects of using multiple small sediment diversions from the Mississippi River. The theory behind this approach is that multiple small diversions could nourish and build land effectively while also maintaining ecosystem services at their current levels in their current locations. The multiple small diversion project modeled as part of our analysis actually decreased the level of several ecosystem services, such as oysters, as much or more than the few large sediment diversions found in our Max Land project group. Other ecosystem services, such as waterfowl and freshwater fisheries, showed an equal or slightly increasing level of service compared to our Max Land project group. After a thorough analysis, we found that neither the multiple small diversion project nor our Max Land project group produced large variances overall in the balance of ecosystem services coast wide. However, using multiple small diversions as our restoration technique reduced our land building by 210 to 430 square miles compared to our Max Land project group. Reducing the operation of multiple small diversions to lessen the impact to saltwater dependent species would further shrink our ability to build land. Neither of these were acceptable options.

Large Scale Land Building

Our models evaluated each project's ability to build and sustain land, whether from mechanical means or by using the river. When we evaluated the top 25 individual land building projects, we found they included 11 sediment diversion projects, six channel realignment projects, and eight marsh creation projects.

Channel Realignment

Our analysis indicates that channel realignment projects have strong land building benefits, the best of any individual restoration project type we evaluated (see Figure 4.5). Six of the eight channel realignment projects evaluated in the analysis were among the top 25 individual land building projects under the moderate and less optimistic scenarios.

Figure 4.3
The top 25 individual land building restoration projects under the moderate scenario are comprised of three project types: sediment diversions, channel realignments, and marsh creation. Each bar represents total land built by an individual project 50 years after construction.

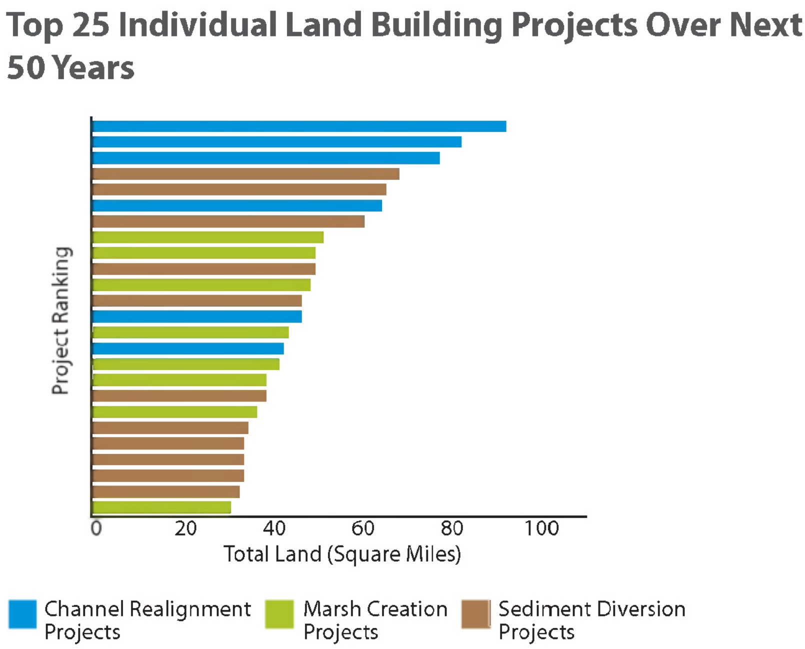
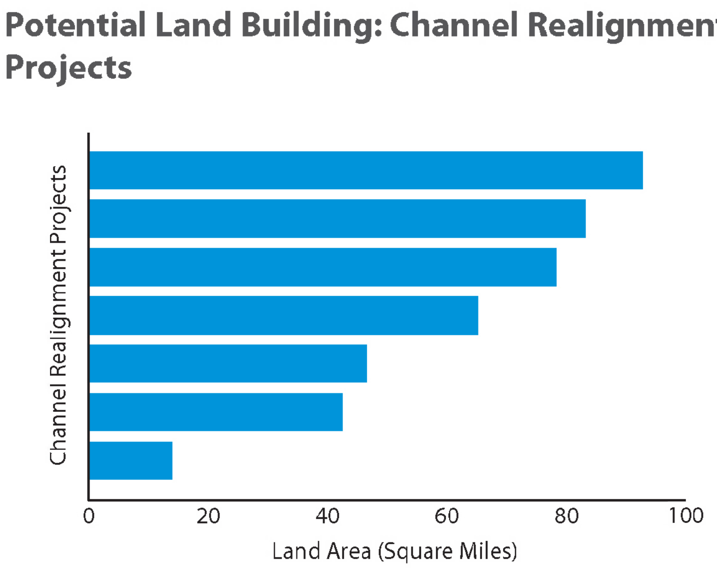


Figure 4.4
Channel realignment projects have great individual land building potential. Each bar represents total land built by an individual project 50 years after construction. Land building can range from 14 to 93 square miles in 50 years under the moderate scenario. Figure does not include the Pass a Loutre project, which is a channel realignment with multiple diversions.



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Working in a Complex World

Reality Check

As we made these decisions and narrowed our project options, we had to confront real world constraints and challenges. These influenced the projects we included in the master plan.

Limits of the Analysis

Using land building as one of our two decision drivers kept us focused on a central priority of the master plan. However, this approach also introduced a few limitations into our analysis. Using land building to evaluate projects meant that we could not accurately account for the benefits of all project types. This was particularly true with respect to coastal forest projects, which do not build land per se, but do work to restore or sustain an essential habitat. This is an area of future analysis that the state needs to expand. Demonstration projects can provide on the ground results that will help us understand the complexities of restoring or sustaining these important forest habitats. The Amite River Diversion Canal Spoil Bank Gapping project was included in the plan as a demonstration project to further explore this issue.

Oyster reef restoration is another project type not fully captured using land building as a decision driver. Vertical reefs can protect marsh and reduce storm surge, but they don't build new land. These projects can be particularly useful in areas where marsh creation is less sustainable due to increasing sea level rise and subsidence. Demonstration artificial reef projects will help us make the most of this option, particularly in areas such as Terrebonne Bay where marsh creation alone is not sustainable.

Implementation Challenges

The feasibility of implementing other projects presented a different set of challenges. Rerouting the GIWW south of Houma has long been considered as a way to move Atchafalaya River water to the east. Our analysis showed that this project could achieve some positive benefits. However, there are great challenges involved, including the need to build a new channel through a suburban area, as well as the need for a number of new road crossings. These challenges were not fully considered during the analysis but are considered obstacles that would inhibit the state from implementing this project. Given these challenges, we did not include this project in the master plan.

Variation in Methods

The master plan includes every type of large scale risk reduction and land building tool we have available, including sediment diversions, marsh creation, levees, and other flood protection measures. We tested other options that focused on a single restoration or risk reduction method. For instance, we conducted an experiment that focused on marsh creation projects without diversions. This reduced our land building capacity by half, and the land that was built was not sustainable. We also conducted an experiment that focused on nonstructural protection only. This did not provide adequate levels of flood risk reduction. Another experiment favored projects that focused land building efforts on critical landforms that could provide both benefit to habitats and flood risk reduction. This experiment provided sound risk reduction and land building benefits. We incorporated many of the projects selected in this experiment into the master plan.

Public Input

Local knowledge and preferences were gathered throughout the master plan process. We were able to take recommendations from the public, especially the 2,200 public comments received on the draft plan, and evaluate their implications using our technical tools. For instance, we received public comments that supported and opposed large scale sediment diversions. To investigate what these preferences could mean, we evaluated the removal of both 250,000 cfs diversions off the Mississippi River and the replacement of the 150,000 cfs diversion off the Atchafalaya with a 20,000 cfs diversion. We then used the available funding on other projects that maximized land building without the use of diversions. If we made these modifications to the plan, we would build 180 square miles less land over 50 years and we would still be experiencing land loss at Year 50 (-6 square miles per year). In another case, we were able to modify the location of marsh creation projects, such as those in St. Bernard and Jefferson Parishes, without having a large detrimental effect on our ability to meet our objectives.

Critical Landforms

Restoration of the landscape can provide critical risk reduction value to communities, thereby increasing the benefits that a risk reduction project could provide. In order to capture these multi-purpose restoration projects in the analysis, we evaluated an additional criterion that focused restoration on critical landforms. For this analysis, we considered a critical landform to be one of sixteen landscape features defined by the US Army Corps of Engineer's 2009 Louisiana Coastal Risk Reduction and Restoration Technical Report.

Decision Points:
Using Science and Public Input

The list of projects included in the master plan was developed through a groundbreaking technical process coupled with extensive public engagement. Thus, the master plan projects are not only scientifically sound, but they also have broad based community support. Key decision points used to shape this plan, based on policy decisions and public input, are highlighted below.

Policy Level

- Maximized community flood risk reduction and land building.
- Assumed a $50 billion budget for planning purposes.
- Used a balanced allocation of protection and restoration funds, taking into account that many restoration projects also serve to reduce flooding risk.
- Divided investment equally between near and long term benefits.
- Chose projects that are more robust should future coastal conditions track our less optimistic scenario.
- Ensured that positive and negative effects of projects on ecosystem services were balanced and that negative effects are not significantly detrimental coast wide.
- Focused marsh creation efforts on critical landforms, or key landscape features that provide both land building and storm surge reduction.
- Incorporated projects in the master plan based on a realistic review of the limits of the analysis, implementation challenges, and variations in methods.
- Adjusted projects based on local knowledge and stakeholder input where appropriate. The changes were principled responses to the feedback we received, grounded in science, and responsive to the needs of our coastal communities.

Project Level

- Dedicated funding in the first implementation period to accelerate investigation of the Lake Pontchartrain Barrier as a high priority flood risk reduction project.
- Based on public input, designated funding in the first implementation period to further investigate 500 year protection measures for Lake Charles.
- Based on public input, a structure at Bayou Chene was added to the plan. Although the benefits of this project were not evaluated in the same way as other projects in the plan, this structure has demonstrated on the ground results when addressing river flooding risk.
- Removed SW GIWW Levee because it did not substantially increase flood protection and it disrupted natural processes.
- The Chandeleur Islands project was removed based on the critical landform analysis, which factored in its great distance from communities and associated protection features.
- Designated funding in the first implementation period to further develop the concept of a channel realignment of the Mississippi River in addition to, and in coordination with, the State-Corps Mississippi River Hydrodynamic and Delta Management Study.
- Reduced the overall number of diversions to focus use of the Mississippi River's resources at optimal locations and take fisheries and navigation concerns into account.
- Selected the Mid-Barataria 50,000 cubic feet per second (cfs) sediment diversion for the master plan. Based on our scenario analysis, under less optimistic conditions, it would be more effective for our land building potential to construct a 250,000 cfs sediment diversion at this location. To account for this uncertainty, the project is slated for expansion after 20 years to a 250,000 cfs sediment diversion.
- Our analysis indicated some redundancy in marsh creation projects and diversions, which were building land in the same locations. Two marsh creation projects were removed to address this duplication: Breton Marsh Creation Component B and Bayou Penchant Marsh Creation.
- First implementation period increments were developed for large marsh creation projects that were too expensive to complete in the first period. These projects include Large-Scale Barataria Marsh Creation Component E, New Orleans East Landbridge Restoration, and Belle Pass to Golden Meadow Marsh Creation.

- Removed two hydrologic restoration projects (locks) on the GIWW near Calcasieu Lake based on navigation decision criterion analysis and redundancy with other salinity control measures in the plan.
- Removed GIWW Bypass South of Houma based on challenges to implementation.
- Removed Little Pecan Bayou Hydrologic Restoration because it is being deauthorized by CWPPRA and is not considered implementable.
- The LCA Amite River Diversion Canal Spoil Bank Gapping project was added to the plan. This project can provide monitoring results that increase our understanding of how to sustain coastal forest habitats.
- Based on public input, a Freshwater Bayou Shoreline Protection project was added to protect existing marsh and nearby marsh creation projects from erosion and salt water intrusion.
- Based on public input and its proximity to coastal communities, the Front Ridge restoration project was added to the plan.
- We received many comments regarding the ability of restoration projects to reduce flooding risks. These public recommendations suggested how and where to increase this function, particularly with respect to rock breakwaters in the Chenier Plain and strategic placement of marsh creation in Terrebonne, Lafourche, and St.

Bernard Parishes. The following projects were added or adjusted based on that input.

- Rock breakwaters were incorporated into the Calcasieu-Sabine Shoreline Protection project and Gulf Shoreline Protection (Calcasieu to Rockefeller) was added to the plan to provide over 60 miles of rock or low-wave action breakwaters along the Cameron Parish shoreline.
- Point Au Fer Marsh Creation and Bayou Penchant Marsh Creation were exchanged for North Terrebonne Bay Marsh Creation Component B as it is located closer to communities and provides synergies with the Morganza to the Gulf hurricane protection system.
- North Caminada Marsh Creation was exchanged for Belle Pass to Golden Meadow Marsh Creation to better protect LA Highway 1 and the Larose to Golden Meadow protection system.
- Eastern Lake Borgne Marsh Creation was exchanged for Lake Borgne Marsh Creation Component A to provide better protection to neighboring communities and address an area of greater need.
- Funding was designated in the first implementation period to study the effectiveness and constructability of the Terrebonne Bay Rim Marsh Creation to provide protection to communities and the Morganza to the Gulf protection system.

Chapter 5

2012 Coastal Master Plan

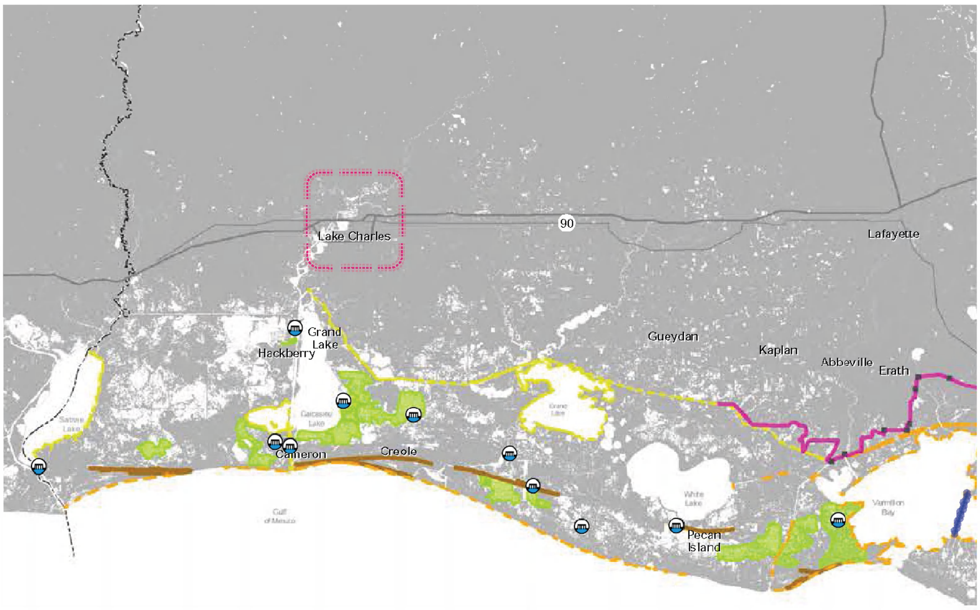
Marsh creation via beneficial use of dredged material in Cameron Parish.

A Robust Plan

Projects Included in the 2012 Coastal Master Plan

Chapter Preview

This chapter presents the projects in the 2012 Coastal Master Plan. Project lists are included, as are detailed descriptions of the flood protection and land building benefits the master plan provides. The final section provides an overview of our implementation and adaptive management approach.



▲ **Figure 5.1**
As described in the Introduction, there are 109 projects in the master plan, representing a variety of project types across the coast.

The 2012 Coastal Master Plan has done something new for our state: offer a path forward based on the latest innovations in science. No planning process can claim to be completely objective, and we have been clear about the limitations of our process. We can say with confidence, however, that the projects presented in this document are the result of an unbiased analysis of the best information available to us. Eighty-five percent of the projects in this plan performed well under one or both future scenarios, and they satisfied multiple stakeholder preferences. We have backed up this assertion with data in our appendices. When we deviated from our science based results because of real world challenges or public input, we have thoroughly documented those decisions.

In the end we found that certain projects, such as levees and large diversions, had to be part of the solution we offered. We also found that it was necessary to use a variety of project types in targeted locations. Finally, we were able to put to rest certain long standing proposals, such as eliminating diversions, using only small diversions, or even relying solely on levees to secure our future. These ideas do not work, as documented in Chapter 4, and they are not reflected in this master plan. The plan does reflect the many promising projects available to help coastal residents and businesses thrive. The projects listed on the following pages thus represent the results of more than two years of exhaustive analysis in support of the resilient and secure future that all Louisianans want.

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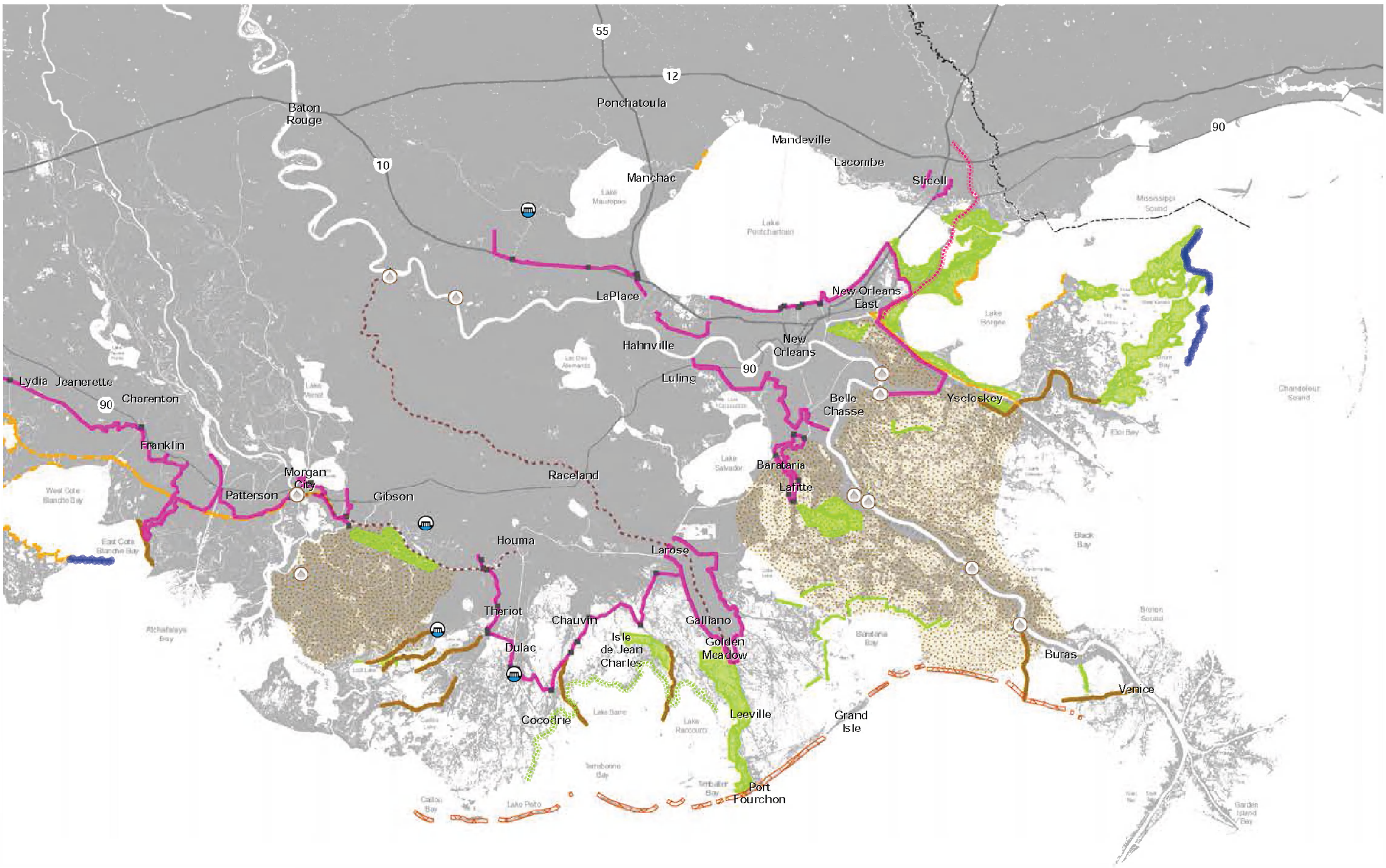
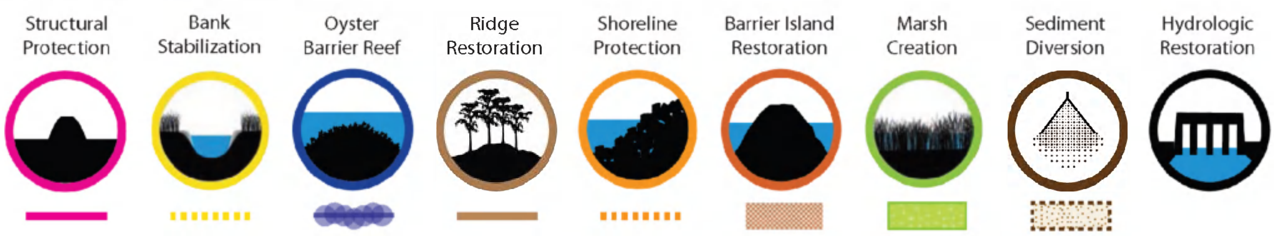


Project Types Included:



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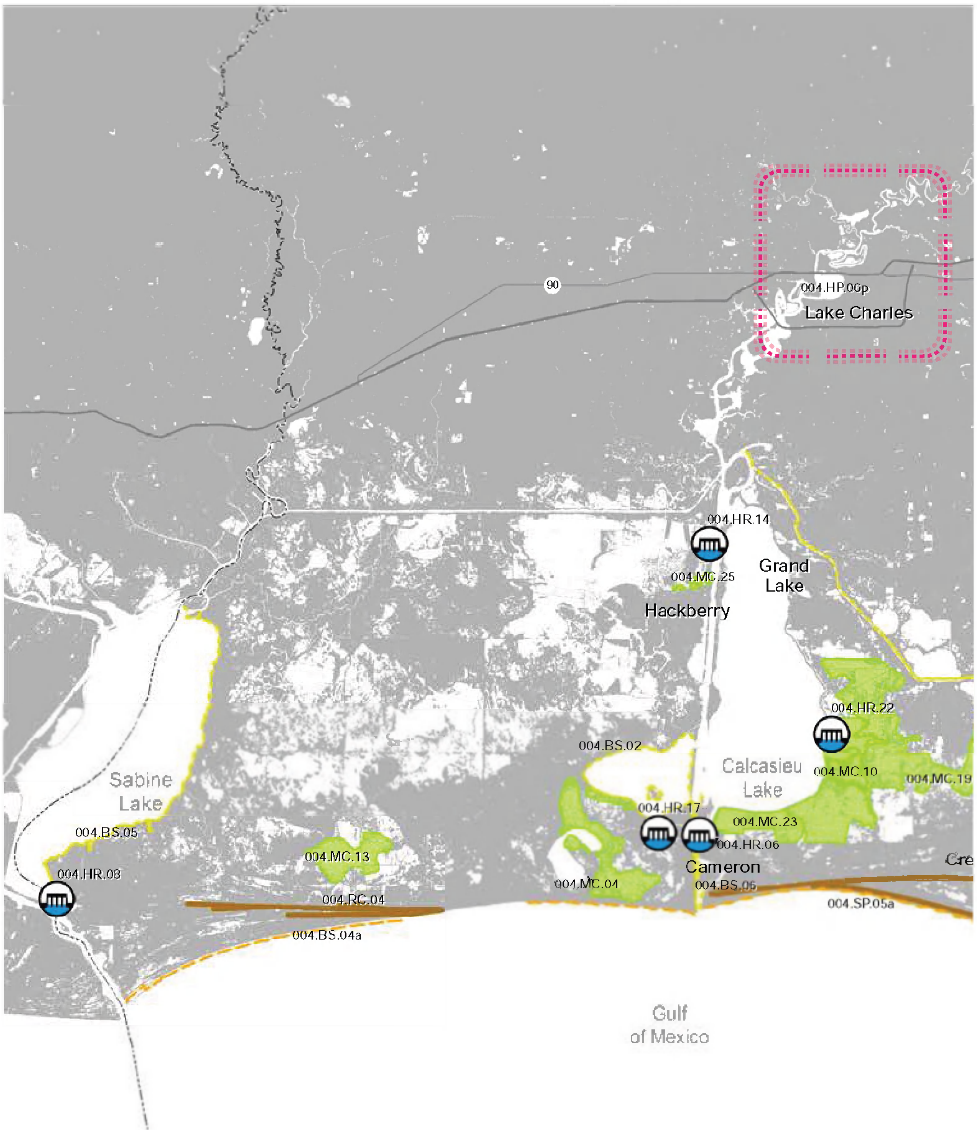
Southwest Coast



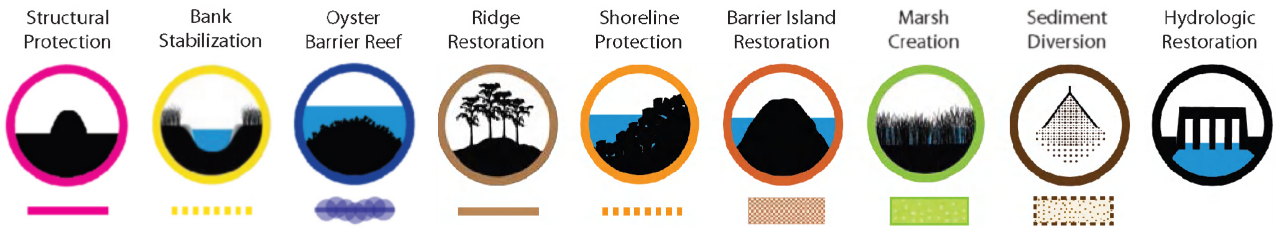
Protection

Protection measures are included for large, densely populated, at-risk communities, such as Lake Charles and Abbeville. Nonstructural measures are included for all parishes in this region. Restoration of chenier ridges, gulf shore protection, and wetlands contribute additional storm surge protection.

Restoration

Restore wetlands and chenier ridges while limiting saltwater intrusion. Maintain and increase, where possible, the input of fresh water to maintain a balance among saline and fresh wetlands.

Project Types Included:



▲ **Figure 5.2**
Southwest Coast Project Map. Note: nonstructural projects are not shown.

Southwest Coast

1st Implementation Period (2012-2032)

Project Type	Project Name	Project Costs	Project No.
Bank Stabilization	Grand Lake Bank Stabilization: Bank stabilization through earthen fill placement and vegetative plantings of approximately 497,000 feet of perimeter shoreline at Grand Lake to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$74M	004.BS.01
	West Cove Bank Stabilization: Bank stabilization through earthen fill placement and vegetative plantings of approximately 106,000 feet of perimeter shoreline in the West Cove area of Calcasieu Lake to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$16M	004.BS.02
	GIWW Bank Stabilization (Freshwater Bayou to Calcasieu Ship Channel): Bank stabilization through earthen fill placement and vegetative plantings of approximately 421,000 feet of GIWW bankline between Freshwater Bayou Canal and Calcasieu Ship Channel.	$63M	004.BS.03
	Sabine Lake Bank Stabilization: Bank stabilization through earthen fill placement and vegetative plantings of approximately 133,000 feet of the eastern shoreline of Sabine Lake to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$21M	004.BS.05
	Calcasieu Ship Channel Bank Stabilization (Gulf to Calcasieu Lake): Bank stabilization through earthen fill and placement of approximately 75,000 feet of Calcasieu Ship Channel bankline from the Gulf of Mexico to Calcasieu Lake to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$12M	004.BS.06
Hydrologic Restoration	Calcasieu Ship Channel Salinity Control Measures: Construction of measures designed to prevent saltwater from entering Calcasieu Lake through the Calcasieu Ship Channel. Measures would control salinity spikes, provide storm surge benefits, and would be constructed in a manner that would allow for the continued functioning, and ideally improvement and increased viability of the Calcasieu Ship Channel and the Port of Lake Charles.	$398M	004.HR.06
	Little Pecan Bayou Sill: Construction of a saltwater sill at the confluence of Little Pecan Bayou and the Mermentau River to retain freshwater and reduce saltwater intrusion in the Mermentau watershed.	$5M	004.HR.07
	Sabine Pass Hydrologic Restoration: Isolation of the southern end of Sabine Lake from the Sabine Ship Channel through a rock dike to retain freshwater in Sabine Lake and reduce saltwater intrusion from the ship channel.	$33M	004.HR.08
	Tom's Bayou Hydrologic Restoration: Construction of a sheetpile crested weir at Tom's Bayou to provide salinity control for Rainey Marsh.	$1M	004.HR.12
	Deep Lake Hydrologic Restoration: Dredging of a 700-foot spillway structure (with 100-foot width and 15-foot depth) north of Deep Lake to increase freshwater exchange within the Rockefeller Wildlife Management Area and Game Preserve.	$2M	004.HR.13
	Alkali Ditch Area Hydrologic Restoration: Construction of structures at Alkali Ditch, Crab Gully, and Black Lake Bayou to provide salinity control in the Calcasieu watershed.	$38M	004.HR.14
	Oyster Bayou Hydrologic Restoration: Construction of a salinity barrier at Oyster Bayou south of West Cove, Calcasieu Lake to reduce saltwater intrusion into the Calcasieu watershed.	$5M	004.HR.17
	Mermentau Basin Hydrologic Restoration (East of Calcasieu Lake): Construction of a water control structure east of Calcasieu Lake with operation to introduce freshwater to wetlands west of Highway LA-27 near Creole.	$7M	004.HR.18
	Mermentau Basin Hydrologic Restoration (South of Grand Lake): Construction of a water control structure south of Grand Lake with operation to introduce freshwater to wetlands south of Highway LA-82 near Grand Chenier.	$7M	004.HR.19
	Mermentau Basin Hydrologic Restoration (South of White Lake): Construction of a water control structure south of White Lake with operation to introduce freshwater to wetlands south of Highway LA-82 near Pecan Island.	$7M	004.HR.20

Figure 5.3
Projects are organized by implementation period and project type. See Appendix A for additional information.

Introduction | 1: Guidelines for the Master Plan | 2: Identifying Projects | 3: Evaluating Projects | 4: Developing the Plan | 5: 2012 Coastal Master Plan | 6: Policies & Programs

Project Type	Project Name	Project Costs	Project No.
Hydrologic Restoration (cont.)	East Calcasieu Lake Hydrologic Restoration: Dredging of a 1,500-foot spillway structure (with 200-foot width and 15-foot depth) in the Cameron-Creole Levee at East Calcasieu Lake to increase freshwater exchange with adjacent wetlands.	$5M	004.HR.22
Marsh Creation	East Rainey Marsh Creation: Creation of approximately 3,080 acres of marsh in the eastern portion of Rainey Marsh to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$429M	03b.MC.07
	South Grand Chenier Marsh Creation: Creation of approximately 7,330 acres of marsh south of Highway LA-82 near Grand Chenier to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$708M	004.MC.01
	Mud Lake Marsh Creation: Creation of approximately 3,910 acres of marsh at Mud Lake south of West Cove, Calcasieu Lake to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$581M	004.MC.04
	West Rainey Marsh Creation: Creation of approximately 3,550 acres of marsh at Rainey Marsh near the southeast bank of the Freshwater Bayou Canal to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$615M	004.MC.07
	Southeast Calcasieu Lake Marsh Creation: Creation of approximately 7,600 acres of marsh southeast of Calcasieu Lake to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$666M	004.MC.10
	Cameron Meadows Marsh Creation: Creation of approximately 3,290 acres of marsh at Cameron Meadows north of Johnsons Bayou to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$290M	004.MC.13
	East Pecan Island Marsh Creation: Creation of approximately 7,340 acres of marsh between Pecan Island and the west bank of the Freshwater Bayou Canal to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$1,180M	004.MC.16
	Calcasieu Ship Channel Marsh Creation: Creation of approximately 2,640 acres of marsh south of Calcasieu Lake near Cameron to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$185M	004.MC.23
Ridge Restoration	Grand Chenier Ridge Restoration: Restoration of approximately 86,000 feet (200 acres) of historic ridge at Grand Chenier Ridge to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$11M	004.RC.01
	Cheniere au Tigre Ridge Restoration: Restoration of approximately 60,000 feet (140 acres) of historic ridge along Bill Ridge and Cheniere au Tigre near the Gulf shoreline to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$10M	004.RC.02
	Pecan Island Ridge Restoration: Restoration of approximately 44,000 feet (100 acres) of historic ridge along Pecan Island Ridge to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$8M	004.RC.03
	Hackberry Ridge Restoration: Restoration of approximately 130,000 feet (300 acres) of historic ridge along Blue Buck and Hackberry Ridges to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$2M	004.RC.04

Southwest Coast

Project Type	Project Name	Project Costs	Project No.
Shoreline Protection	Freshwater Bayou Shoreline Protection (Belle Isle Canal to Lock): Shoreline protection through rock breakwaters of approximately 41,000 feet of Freshwater Bayou shoreline from Belle Isle Canal to Freshwater Bayou Lock to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$43M	03b.SP.01
	Gulf Shoreline Protection (Freshwater Bayou to Southwest Pass): Shoreline protection through rock breakwaters of approximately 90,000 feet of Gulf shoreline from Freshwater Bayou to Southwest Pass (near Marsh Island) to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$96M	03b.SP.05
	Calcasieu-Sabine Shoreline Protection-Component A: Shoreline protection through rock breakwaters of approximately 38,000 feet of Gulf shoreline between Sabine River and Calcasieu Ship Channel to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$48M	004.BS.04a
	Freshwater Bayou Canal Shoreline Protection: Shoreline protection through rock breakwaters of approximately 11,000 feet of Freshwater Bayou Canal bankline at Little Vermilion Bay to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$13M	004.SP.03
	Gulf Shoreline Protection (Calcasieu River to Rockefeller): Shoreline protection through rock and low wave-action breakwaters of approximately 290,000 feet of Gulf shoreline between Calcasieu River and Freshwater Bayou to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$401M	004.SP.05a
	Northeast White Lake Shoreline Protection: Shoreline Protection through rock breakwaters of approximately 3,000 feet of White Lake shoreline near Schooner Bayou Canal to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$4M	004.SP.07
Structural Protection	Iberia/Vermilion Upland Levee: Construction of a levee to an elevation of 21.5 feet along the marsh/upland interface in Iberia and Vermilion Parishes between Bayou Carlin and the Warren Canal. Project features include approximately 218,000 feet of earthen levee, 8,000 feet of concrete T-wall, three 110-foot barge gates, and two 220-foot barge gates.	$1,349M	03b.HP.06
Multiple Protection Measures	Lake Charles 500-Year Protection: Planning and design of multiple measures (marsh creation, ridge restoration, gates, nonstructural, etc.) that will provide protection to the Greater Lake Charles Region- East and West Side of Calcasieu. PLANNING AND DESIGN ONLY.	$83M	004.HP.06p

Introduction

1: Guidelines for the Master Plan

2: Identifying Projects

3: Evaluating Projects

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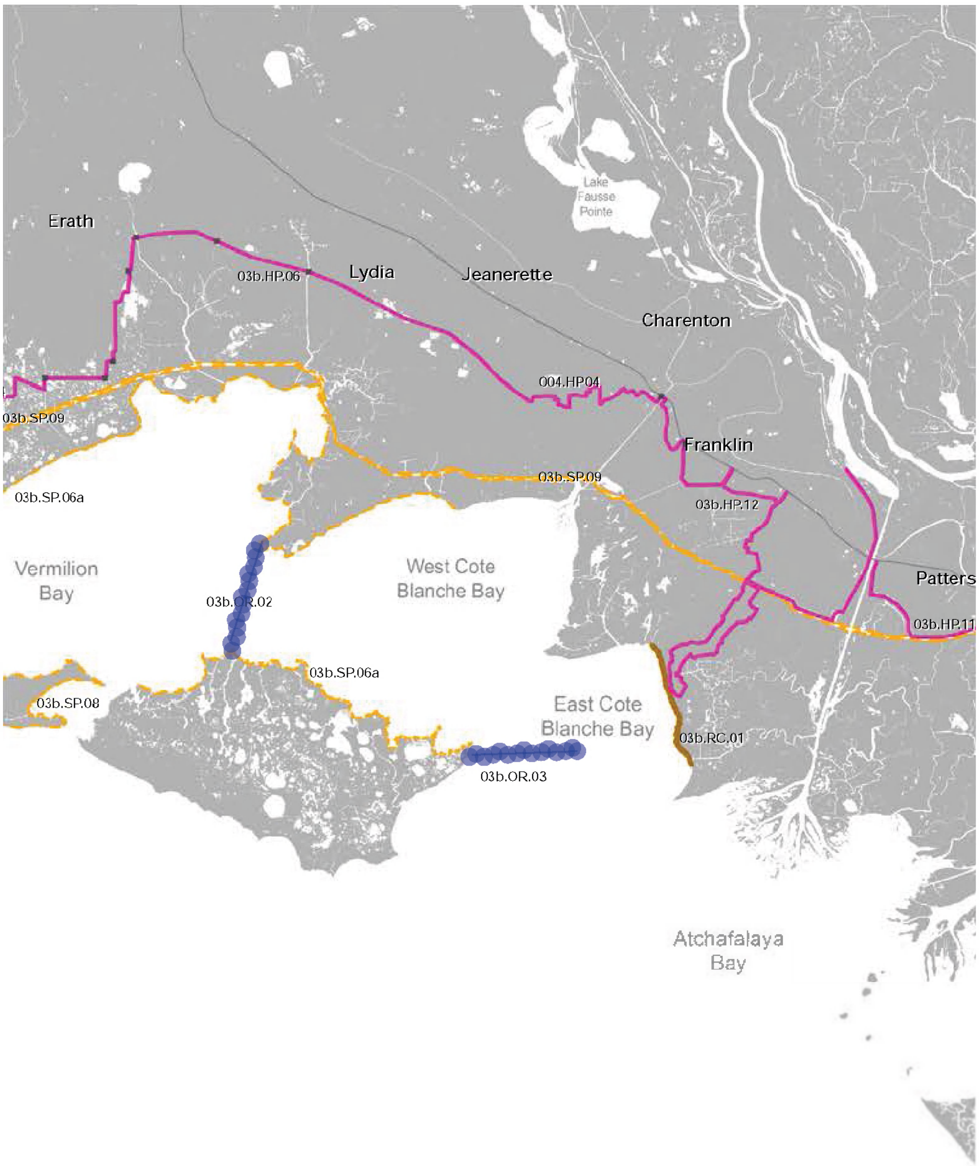
5: 2012 Coastal Master Plan

6: Policies & Programs

2nd Implementation Period (2032-2061)

Project Type	Project Name	Project Costs	Project No.
Marsh Creation	East Calcasieu Lake Marsh Creation: Creation of approximately 14,840 acres of marsh in the eastern Cameron-Creole watershed to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$2,484M	004.MC.19
	Kelso Bayou Marsh Creation: Creation of approximately 260 acres of marsh at Kelso Bayou immediately west of Calcasieu Ship Channel to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$32M	004.MC.25
Ridge Restoration	Front Ridge Restoration: Restoration of approximately 147,000 feet (340 acres) of historic ridge along Front Ridge east of Cameron to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$26M	004.RC.05
Shoreline Protection	Southwest Pass Shoreline Protection (West Side): Shoreline protection through rock breakwaters of approximately 37,000 feet of shoreline along Southwest Pass immediately west of Marsh Island to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$40M	03b.SP.08
	Schooner Bayou Canal Shoreline Protection: Shoreline protection through rock breakwaters of approximately 21,000 feet of Schooner Bayou Canal bankline from Highway 82 to North Prong to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$23M	004.SP.02
Multiple Protection Measures	Lake Charles 500-Year Protection-Construction: Construction of protection measures selected and designed by 004.HP.06p within the Greater Lake Charles Region: East and West Side of Calcasieu. CONSTRUCTION ONLY.	$1,048M	004.HP.06c

Central Coast



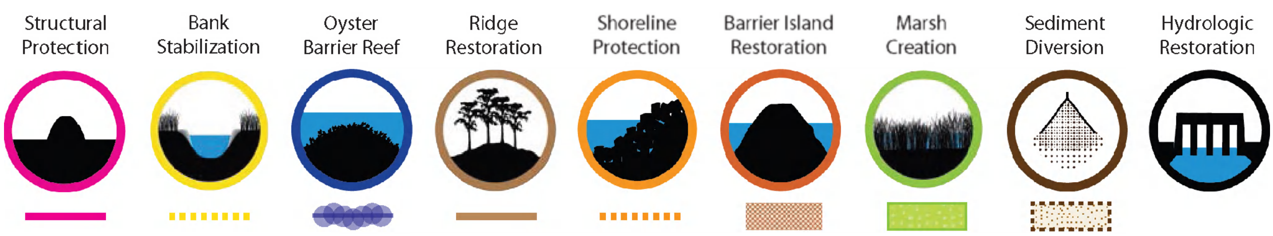
Protection

Levee protection is included for large, densely populated, at-risk communities, including Franklin, New Iberia, Morgan City and Houma. Nonstructural measures are included for all parishes in this region. Restoration of marshes, barrier islands, and ridges contribute additional protection.

Restoration

Maintain the land building capacity of the Atchafalaya region, while increasing the use of Atchafalaya River sediment and water east to Terrebonne Parish to sustain the coastal ecosystem. Rebuild marshes, barrier islands, and ridges.

Project Types Included:



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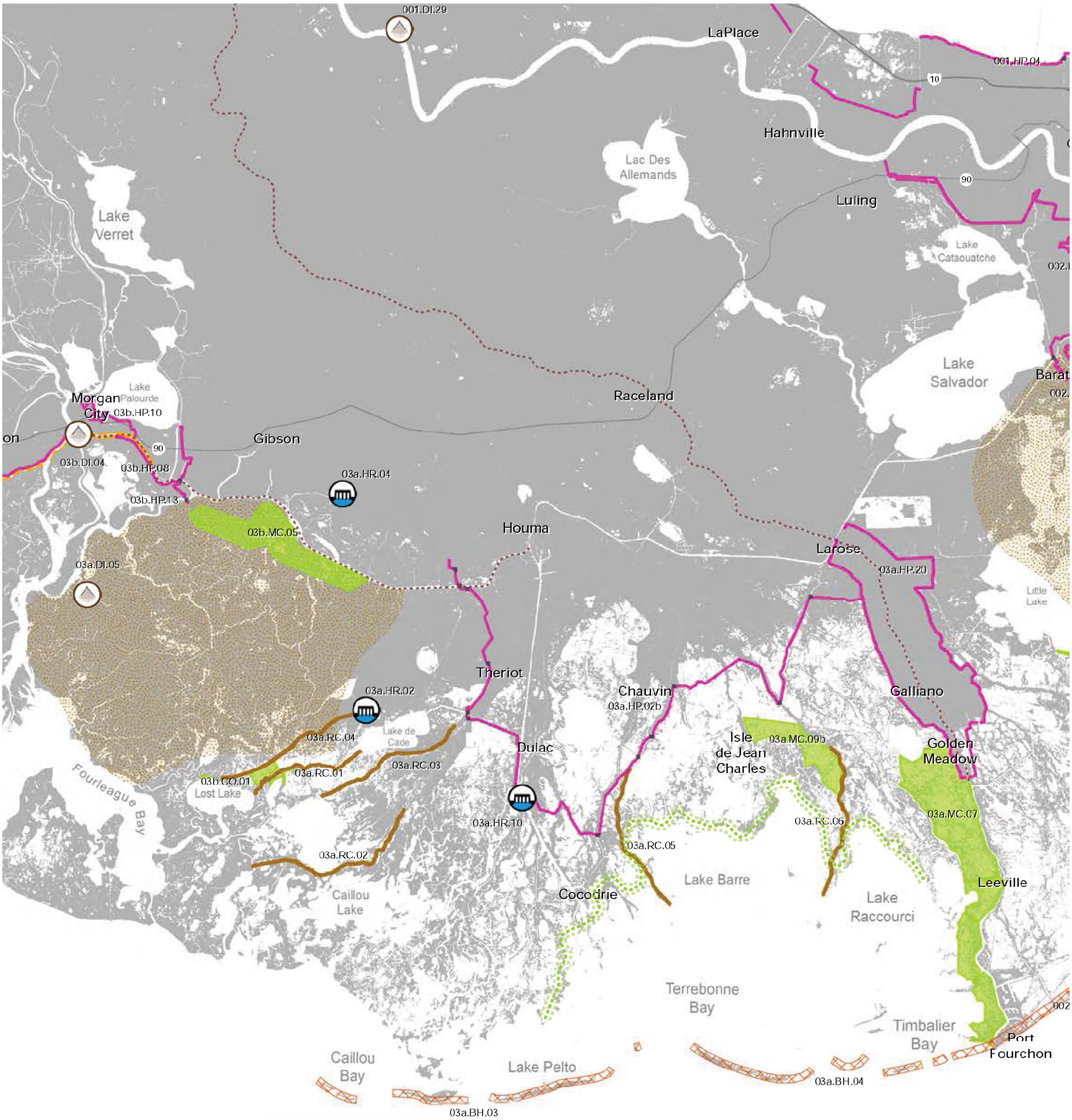


Projects for Accelerated Planning:

Terrebonne Bay Rim Marsh Creation

▲ **Figure 5.4**
Central Coast Project Map. Note: nonstructural projects are not shown.

Central Coast

1st Implementation Period (2012-2031)

Project Type	Project Name	Project Costs	Project No.
Barrier Island/ Headland Restoration	Isles Dernieres Barrier Island Restoration: Restoration of the Isles Dernieres barrier islands to provide dune, beach, and back barrier marsh habitat and to provide storm surge and wave attenuation in the Terrebonne Basin.	$343M	03a.BH.03
	Timbalier Islands Barrier Island Restoration: Restoration of the Timbalier barrier islands to provide dune, beach, and back barrier marsh habitat and to provide storm surge and wave attenuation in the Terrebonne Basin.	$524M	03a.BH.04
Sediment Diversion	Atchafalaya River Diversion (150,000 cfs): Sediment diversion off of the Atchafalaya River into or to benefit Penchant and southwest Terrebonne marshes, 150,000 cfs capacity (modeled at 60% of southward Atchafalaya flow exceeding 50,000 cfs).	$783M	03a.DI.05
	Increase Atchafalaya Flow to Eastern Terrebonne: Dredging of the GIWW east of the Atchafalaya and installation of a bypass structure at the Bayou Boeuf Lock to increase freshwater and sediment flows from Atchafalaya River to Terrebonne marshes (modeled to maintain a minimum of 20,000 cfs east along GIWW towards HNC).	$292M	03b.DI.04
Hydrologic Restoration	Central Terrebonne Hydrologic Restoration: Modification of structure on Liners Canal to improve freshwater flow to Lake Decade and installation of a structure in Grand Pass to restrict the opening to Lake Mechant.	$14M	03a.HR.02
	Chacahoula Basin Hydrologic Restoration: Installation of three water control structures (culverts) to increase hydraulic connectivity in the Chacahoula Basin on either side of Highway 182.	$7M	03a.HR.04
	HNC Lock Hydrologic Restoration: Construction of a lock on the Houma Navigation Canal and operation to reduce saltwater intrusion and distribute freshwater to the surrounding wetlands.	$180M	03a.HR.10
Marsh Creation	Terrebonne Bay Rim Marsh Creation Study: Planning, engineering and design to develop marsh creation along the northern rim of Terrebonne Bay (approximately 3,370 acres). PLANNING AND DESIGN ONLY.	$91M	03a.MC.03p
	Belle Pass-Golden Meadow Marsh Creation (1st Period Increment): Creation of approximately 14,420 acres from Belle Pass to Golden Meadow to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$732M	03a.MC.07
	North Terrebonne Bay Marsh Creation-Component B: Creation of approximately 4,940 acres of marsh south of Montegut between Bayou St. Jean Charles and Bayou Pointe au Chien to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$1555M	03a.MC.09b
	Terrebonne GIWW Marsh Creation: Creation of approximately 1,190 acres of marsh along the GIWW in Terrebonne Basin to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$37M	03b.MC.05
Oyster Barrier Reef	West Cote Blanche Bay Oyster Barrier Reef Restoration: Creation of approximately 28,000 feet of oyster barrier reef in West Cote Blanche Bay from Dead Cypress Point (near Cypremort Point) to near Bayou Michael (NW corner of Marsh Island) to provide oyster habitat, reduce wave erosion, and prevent further marsh degradation.	$20M	03b.OR.02
	East Cote Blanche Bay Oyster Barrier Reef Restoration: Creation of approximately 30,000 feet of oyster barrier reef in East Cote Blanche Bay from Marone Point to Lake Point (NE corner of Marsh Island) to provide oyster habitat, reduce wave erosion, and prevent further marsh degradation.	$22M	03b.OR.03
Ridge Restoration	Bayou DeCade Ridge Restoration: Restoration of approximately 47,000 feet (110 acres) of historic ridge along Bayou DeCade from Lake Decade to Raccourci Bay to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$38M	03a.RC.01
	Bayou DuLarge Ridge Restoration: Restoration of approximately 106,000 feet (240 acres) of historic ridge along Bayou DuLarge to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$56M	03a.RC.02

Figure 5.5
Projects are organized by implementation period and project type. See Appendix A for additional information.

Project Type	Project Name	Project Costs	Project No.
Ridge Restoration (cont.)	Small Bayou LaPointe Ridge Restoration: Restoration of approximately 55,000 feet (130 acres) of historic ridge along Small Bayou LaPointe to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$29M	03a.RC.03
	Mauvais Bois Ridge Restoration: Restoration of approximately 60,000 feet (140 acres) of historic ridge at Mauvais Bois to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$37M	03a.RC.04
	Bayou Terrebonne Ridge Restoration: Restoration of approximately 55,000 feet (130 acres) of historic ridge along the southern portions of Bayou Terrebonne to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$38M	03a.RC.05
	Bayou Pointe au Chene Ridge Restoration: Restoration of approximately 57,000 feet (130 acres) of historic ridge along the southern portions of Bayou Pointe au Chene to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$30M	03a.RC.06
	Bayou Sale Ridge Restoration: Restoration of approximately 36,000 feet (80 acres) of historic ridge along Bayou Sale to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$22M	03b.RC.01
Structural Protection	Morganza to the Gulf (high): Construction of a levee to an elevation of 19.6-36.5 feet around Houma and the Terrebonne ridge communities between Larose and Humphreys for hurricane storm surge risk reduction. Project features include approximately 319,000 feet of levee, 19,000 feet of concrete T-wall, four 56-foot sector gates, eight 110-foot barge gates, two 220-foot barge gates, and a lock complex on the Houma Navigation Canal.	$3,964M	03a.HP.02b
	Maintain Larose to Golden Meadow: Maintenance of the existing Larose to Golden Meadow levees at design elevation for the 50-year period of analysis. Project features include maintenance lifts of approximately 247,000 feet of earthen levee to account for compaction and subsidence.	$228M	03a.HP.20
	Amelia Levee Improvements (3E): Construction of a levee to an elevation of 18.0 feet around Amelia along the GIWW between Lake Palourde and the Bayou Boeuf Lock for hurricane storm surge risk reduction. Project features include approximately 56,000 feet of earthen levee, 1,600 feet of concrete T-wall, and one 220-foot barge gate.	$257M	03b.HP.08
	Morgan City Back Levee: Construction of a levee to an elevation of 13.5 feet along the south shore of Lake Palourde in the vicinity of Morgan City for hurricane storm surge risk reduction. Project features include approximately 39,000 feet of earthen levee, 1,000 feet of concrete T-wall, and one 110-foot barge gate.	$138M	03b.HP.10
	Bayou Chene Floodgate: Construction of a floodgate and associated levee to an elevation of 10 feet across Bayou Chene. Project features include approximately 32,000 feet of earthen levee and one 420-foot floodgate.	$80M	03b.HP.13
	Abbeville and Vicinity: Construction of a levee to an elevation of 17-20 feet in the vicinity of the marsh-upland interface between Abbeville and the Charenton Drainage and Navigation Canal for hurricane storm surge risk reduction. Project features include approximately 202,000 feet of earthen levee, 6,000 feet of concrete T-wall, two 56-foot sector gates and two 110-foot barge gates.	$958M	004.HP04

Central Coast

2nd Implementation Period (2032-2061)

Project Type	Project Name	Project Costs	Project No.
Marsh Creation	Belle Pass-Golden Meadow Marsh Creation (2nd Period Increment): Creation of approximately 14,420 acres from Belle Pass to Golden Meadow to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$2,927M	03a.MC.07
	North Lost Lake Marsh Creation: Creation of approximately 850 acres of marsh between Lake Pagie and Bayou Decade to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$125M	03b.CO.01
Shoreline Protection	Vermilion Bay and West Cote Blanche Bay Shoreline Protection (Critical Areas): Shoreline protection through rock breakwaters of approximately 83,000 feet of shoreline along Vermilion Bay and West Cote Blanche Bay to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$86M	03b.SP.06a
	GIWW Shoreline Protection (Intracoastal City to Amelia): Shoreline protection of approximately 690,000 feet of GIWW shoreline between Intracoastal City and Amelia to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$765M	03b.SP.09
Structural Protection	Berwick to Wax Lake: Construction of a levee to an elevation of 18.0 feet south of Berwick and Patterson along the GIWW between the Atchafalaya River and the Wax Lake Outlet. Project features include approximately 72,000 feet of earthen levee.	$253M	03b.HP.11
	Franklin and Vicinity: Construction of a levee to an elevation of 16.5 feet between the Wax Lake Outlet and the Charenton Drainage and Navigation Canal along the north bank of the GIWW, with a separate polder along Bayou Sale south of the GIWW. Project features include approximately 284,000 feet of levees, 1,000 feet of concrete T-wall, one 110-foot barge gate, and five pumps with a combined capacity of 2,700 cfs.	$975M	03b.HP.12

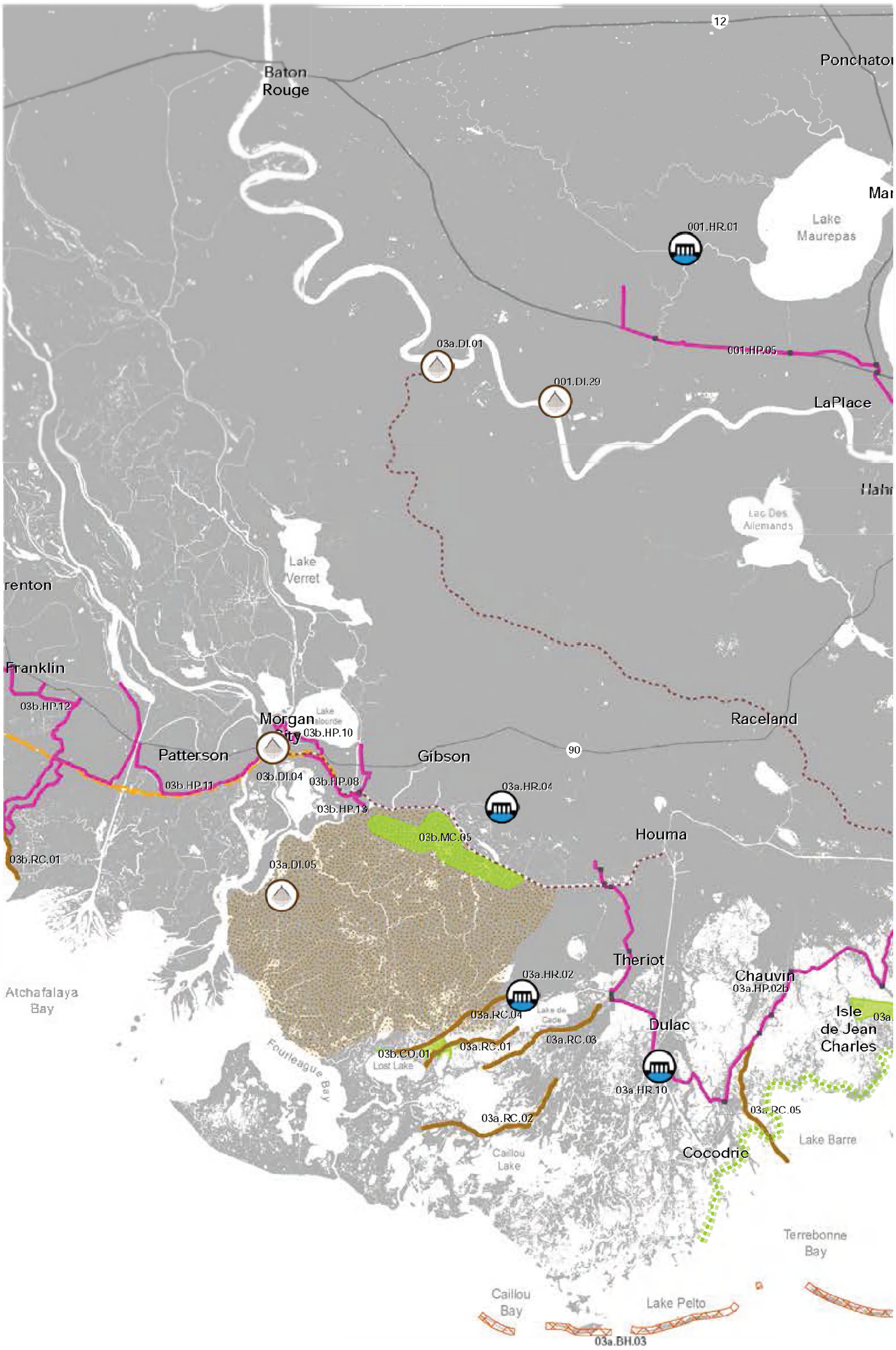
Southeast Coast

Protection

Sustain key levee protection systems, such as Greater New Orleans area and Larose to Golden Meadow. New levees are included for large, densely populated, at risk communities, such as LaPlace, Lafitte, and Slidell. Nonstructural protection measures are included for all parishes in this region.

Restoration

Use sediment and water from the Mississippi River to sustain and rebuild land. Sustain a diversity of coastal habitats including cypress swamps, marshes, barrier islands, and ridges.



Project Types Included:

Structural Protection | Bank Stabilization | Oyster Barrier Reef

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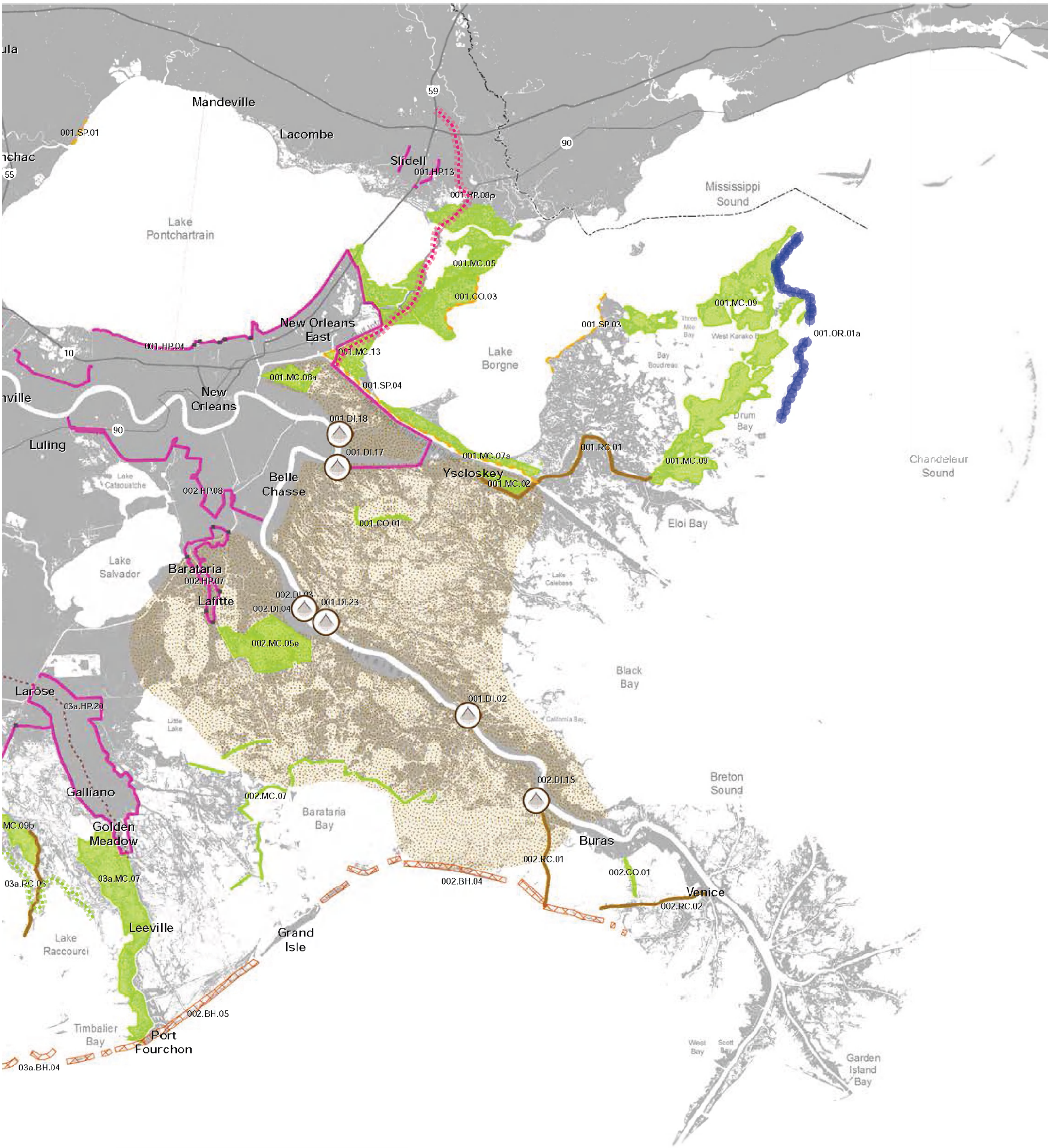


Projects for Accelerated Planning:

Lake Pontchartrain Barrier

Channel Realignment (not shown)

Figure 5.6
Southeast Coast Project Map. Note: nonstructural projects are not shown.

Southeast Coast

1st Implementation Period (2012-2031)

Project Type	Project Name	Project Costs	Project No.
Barrier Island/ Headland Restoration	Barataria Pass to Sandy Point Barrier Island Restoration: Restoration of Barataria Bay barrier islands between Barataria Pass and Sandy Point to provide dune and back barrier marsh habitat and to provide storm surge and wave attenuation for the Barataria Basin.	$535M	002.BH.04
	Belle Pass to Caminada Pass Barrier Island Restoration: Restoration of Barataria Bay barrier islands between Belle Pass and Caminada Pass to provide dune, beach, and back barrier marsh habitat and to provide storm surge and wave attenuation for the Barataria Basin.	$281M	002.BH.05
Channel Realignment	Mississippi River Channel Realignment: Planning, engineering and design to explore potential locations and discharge regimes for a channel realignment. PLANNING AND DESIGN ONLY.	$73M	001.DI.39p
Sediment Diversion	Lower Breton Diversion (50,000 cfs): Sediment diversion into lower Breton Sound in the vicinity of Black Bay to build and maintain land, 50,000 cfs capacity (modeled at 50,000 cfs when Mississippi River flow exceeds 600,000 cfs, at 8% of river flows between 200,000-600,000 cfs, and no operation when river flow is below 200,000 cfs).	$212M	001.DI.02
	Upper Breton Diversion (250,000 cfs): Sediment diversion into upper Breton Sound in the vicinity of Braithwaite to build and maintain land, 250,000 cfs capacity (modeled at 250,000 cfs when Mississippi River flow exceeds 900,000 cfs, at 50,000 cfs for river flows between 600,000-900,000 cfs, at 8% of river flows between 200,000-600,000 cfs, and no operation when river flow is below 200,000 cfs).	$885M	001.DI.17
	Central Wetlands Diversion (5,000 cfs): Sediment diversion into Central Wetlands in the vicinity of Violet to provide sediment for emergent marsh creation and nutrients to sustain existing wetlands, 5,000 cfs capacity (modeled at 5,000 cfs when Mississippi River flow exceeds 200,000 cfs and no operation for river flows below 200,000 cfs).	$189M	001.DI.18
	Mid-Breton Diversion (5,000 cfs): Sediment diversion into mid-Breton Sound in the vicinity of White Ditch to build and maintain land, 5,000 cfs capacity (modeled at 5,000 cfs for river flows above 200,000 cfs and no operation below 200,000 cfs).	$123M	001.DI.23
	West Maurepas Diversion (5,000 cfs): Diversion(s) into western Maurepas Swamp in the vicinity of Convent/Blind River or Hope Canal to sustain existing bald cypress-tupelo swamp habitat, maximum capacity 5,000 cfs (modeled at 5,000 cfs when Mississippi River flow exceeds 600,000 and at 500 cfs for river flows between 200,000-600,000 cfs).	$127M	001.DI.29
	Mid-Barataria Diversion (250,000 cfs- 1st Period Increment): Sediment diversion into mid-Barataria in the vicinity of Myrtle Grove to build and maintain land, maximum capacity 50,000 cfs (modeled at 50,000 cfs when the Mississippi River flow exceeds 600,000 cfs, at 8% of river flows between 200,000-600,000 cfs, and no operation below 200,000 cfs). NOTE: This project is the first implementation period component of a 250,000 cfs diversion to mid-Barataria. The influence area shown is for the total 250,000 cfs project upon completion in the second implementation period.	$275M	002.DI.03
	Lower Barataria Diversion (50,000 cfs): Sediment diversion into lower Barataria Bay in the vicinity of Empire, 50,000 cfs capacity (modeled at capacity when Mississippi River flow exceeds 600,000 cfs; modeled at 8% of river flow from 600,000 cfs down to 200,000 cfs; no operation below 200,000 cfs).	$203M	002.DI.15
	Bayou Lafourche Diversion (1,000 cfs): Diversion of the Mississippi River into Bayou Lafourche to increase freshwater flow down Bayou Lafourche, 1,000 cfs capacity (modeled with continuous operation at 1,000 cfs).	$189M	03a.DI.01
Hydrologic Restoration	Amite River Diversion Canal: Hydrologic restoration in the western Maurepas Swamp by gapping spoil banks along the Amite River Diversion Canal to eliminate impoundment and restore hydrologic exchange.	$4M	001.HR.01

▼ **Figure 5.7**
Projects are organized by implementation period and project type. See Appendix A for additional information.

Project Type	Project Name	Project Costs	Project No.
Marsh Creation	South Lake Lery Marsh Creation: Creation of approximately 450 acres of marsh along the south shore of Lake Lery to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$36M	001.CO.01
	Hopedale Marsh Creation: Creation of approximately 550 acres of marsh in northern Breton Sound in the vicinity of Hopedale to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$147M	001.MC.02
	New Orleans East Landbridge Restoration (1st Period Increment): Creation of approximately 8,510 acres of marsh in the New Orleans East Landbridge to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$473M	001.MC.05
	Lake Borgne Marsh Creation-Component A: Creation of approximately 2,230 acres of marsh along the south shoreline of Lake Borgne near Proctors Point to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$620M	001.MC.07a
	Central Wetlands Marsh Creation-Component A: Creation of approximately 2,010 acres of marsh in Central Wetlands near Bayou Bienvenue to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$234M	001.MC.08a
	Golden Triangle Marsh Creation: Creation of approximately 2,440 acres of marsh in the Golden Triangle area to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$293M	001.MC.13
	Large-Scale Barataria Marsh Creation-Component E (1st Period Increment): Creation of approximately 8,070 acres of marsh in the Barataria Basin to address the Barataria Landbridge to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$495M	002.MC.05e
	Grand Liard Marsh/Ridge Restoration: Restoration of 560 acres of marsh and historic ridge in the vicinity of Grand Liard to provide wetland and upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$34M	002.CO.01
Oyster Barrier Reef	Biloxi Marsh Oyster Reef: Creation of approximately 113,000 feet of oyster barrier reef along the eastern shore of Biloxi Marsh to provide oyster habitat, reduce wave erosion, and prevent further marsh degradation.	$83M	001.OR.01a
Ridge Restoration	Bayou LaLoutre Ridge Restoration: Restoration of approximately 117,000 feet (270 acres) of historic ridge along Bayou LaLoutre to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$61M	001.RC.01
	Bayou Long Ridge Restoration: Restoration of approximately 49,000 feet (110 acres) of historic ridge along Bayou Long/Bayou Fontanelle to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$37M	002.RC.01
	Spanish Pass Ridge Restoration: Restoration of approximately 53,000 feet (120 acres) of historic ridge along the banks of Spanish Pass near Venice to provide coastal upland habitat, restore natural hydrology, and provide wave and storm surge attenuation.	$43M	002.RC.02

Southeast Coast

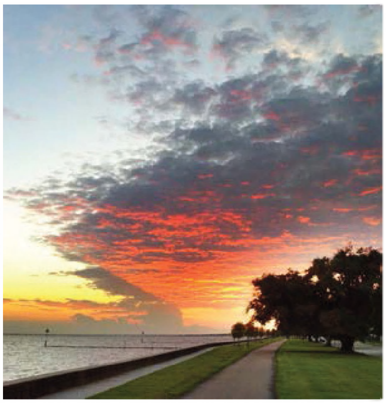
Project Type	Project Name	Project Costs	Project No.
Shoreline Protection	Manchac Landbridge Shoreline Protection: Protection of approximately 8,000 feet of Lake Pontchartrain shoreline north of Pass Manchac near Sinking Bayou through rock breakwaters to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$13M	001.SP.01
	Eastern Lake Borgne Shoreline Protection: Shoreline protection through rock breakwaters of approximately 57,000 feet of the eastern shore of Lake Borgne from Malheureux Point to the vicinity of Point aux Marchettes to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$85M	001.SP.03
	MRGO Shoreline Protection: Shoreline protection through rock breakwaters of approximately 133,000 feet of the north bank of the Mississippi River Gulf Outlet from the Inner Harbor Navigation Canal to Bayou La Loutre to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$195M	001.SP.04
	East New Orleans Landbridge Shoreline Protection: Shoreline protection through rock breakwaters of approximately 27,000 feet of coastal marsh on the east side of the New Orleans Landbridge in the vicinity of Alligator Bend to preserve shoreline integrity and reduce wetland degradation from wave erosion.	$44M	001.CO.03
Structural Protection	Greater New Orleans LaPlace Extension: Construction of a levee to an elevation of 13.5 feet in the LaPlace area for hurricane storm surge risk reduction. Project features include approximately 134,000 feet of earthen levee, 6,000 feet of concrete T-wall, two 40-foot roller gates, and two 110-foot barge gates.	$457M	001.HP.05
	Lake Pontchartrain Barrier: Planning, engineering and design to construct a levee to an elevation of 24.5 feet across the mouth of Lake Pontchartrain from the New Orleans Landbridge to Interstate 59 north of Slidell for hurricane storm surge risk reduction. PLANNING AND DESIGN ONLY.	$76M	001.HP.08p
	Slidell Ring Levee: Construction of a ring levee to an elevation of 16.0 feet around Slidell for hurricane storm surge risk reduction. Project features include approximately 20,000 feet of earthen levee and 16,000 feet of concrete T-wall.	$81M	001.HP.13
	Lafitte Ring Levee: Construction of a ring levee to an elevation of 16.0 feet around Lafitte for hurricane storm surge risk reduction. Project features include approximately 156,000 feet of earthen levee, two 30-foot barge gates, three 40-foot roller gates, one 56-foot roller gate, three 150-foot roller gates, and nine pumps with a combined capacity of 4,800 cfs.	$870M	002.HP.07
	Maintain West Bank Levees: Maintenance of the existing West Bank and Vicinity levees at design elevation for the 50-year period of analysis. Project features include maintenance lifts of approximately 145,000 feet of earthen levee to account for compaction and subsidence.	$193M	002.HP.08

2nd Implementation Period (2032-2061)

Project Type	Project Name	Project Costs	Project No.
Sediment Diversion	Mid Barataria Diversion (250,000 cfs- 2nd Period Increment): Sediment diversion into Mid-Barataria in the vicinity of Myrtle Grove to build and maintain land, 250,000 cfs capacity. NOTE: This project represents the incremental expansion of the 50,000 cfs diversion (002.DI.03) to mid-Barataria (constructed in the 1st Implementation Period) for a total capacity of 250,000 cfs (modeled at 250,000 cfs when Mississippi River flow exceeds 900,000 cfs, at 50,000 cfs for river flows between 600,000-900,000 cfs, at 8% of river flows between 200,000-600,000 cfs, and no operation when river flow is below 200,000 cfs).	$820M	002.DI.03a
Marsh Creation	New Orleans East Landbridge Restoration (2nd Period Increment): Creation of approximately 8,510 acres of marsh in the New Orleans East Landbridge to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$1,890M	001.MC.05
	Biloxi Marsh Creation: Creation of approximately 33,280 acres in the western portion of marsh in Biloxi Marsh from Oyster Bay to Drum Bay to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$3,046M	001.MC.09
	Large-Scale Barataria Marsh Creation-Component E (2nd Period Increment): Creation of approximately 8,070 acres of marsh in the Barataria Basin to address the Barataria Landbridge to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$1,980M	002.MC.05e
	Barataria Bay Rim Marsh Creation: Creation of approximately 2,010 acres of marsh along northern rim of Barataria Bay to create new wetland habitat, restore degraded marsh, and reduce wave erosion.	$216M	002.MC.07
Structural Protection	Greater New Orleans High Level: Construction of a levee to an elevation of 15-35 feet around the Greater New Orleans area from Verret to the Bonnet Carre spillway for hurricane storm surge risk reduction. Project features include approximately 290,000 feet of earthen levee, 16,000 feet of concrete T-wall, armoring of 113,000 feet of existing concrete T-wall, one 40-foot roller gate, two 56-foot sector gates, one 110-foot barge gates, and two 220-foot barge gates.	$1,611M	001.HP.04

In Depth Look:
Developing Protection & Restoration Solutions

The Lake Pontchartrain Barrier Project



The Lake Pontchartrain Barrier project involves building an earthen levee or floodwall along the New Orleans Landbridge with floodgates on the Rigolets and Chef Menteur Passes to prevent storm surge from entering Lake Pontchartrain. A version of the project has been proposed before and was stopped due to environmental concerns. Our analysis indicated that this project holds great promise for reducing risk throughout the North Shore of Lake Pontchartrain and parts of the greater New Orleans area. The project was also one of the most cost effective risk reduction projects analyzed, providing expected annual damage reduction in Year 50 between $2.1 and $10.4 billion, depending on future coastal conditions. However, our analysis also showed that the project increased storm surge flood levels along the Mississippi coast, as well as in New Orleans East and St. Bernard Parish. Our analysis did not calculate the cost of increased flood damages to Mississippi, making us unable to account for those costs when evaluating the effectiveness of this project.

Recognizing the importance and potential of this project, we are dedicating dollars in the master plan to expeditiously determine the most effective way to carry out this project while mitigating any environmental or storm surge issues identified. This investigation will take place in concert with the State of Mississippi and our local partners.

At the same time, given the acute need for flood protection on the North Shore and other communities adjacent to Lake Pontchartrain, we did not want to rely solely on this project to provide risk reduction. Instead, the master plan includes other structural and nonstructural projects, such as the Slidell Ring Levee, that will be pursued on a parallel path. These other projects can provide near term risk reduction while the Lake Pontchartrain Barrier project is fully examined. By exploring the barrier project while also providing immediate risk reduction projects for the region, we will be able to effectively address the flooding risk of Lake Pontchartrain's communities.

Flood Protection Measures for Lake Charles

Lake Charles could experience a three fold increase in risk from storm surge flooding over the next 50 years without restoration of the landscape in the coastal region south of the city. The master plan sets a target of 500 year protection for this area, and we are dedicating master plan dollars to examine how best to achieve this goal. This includes evaluating combinations of marsh creation, ridge restoration, flood gates and other structural measures to meet community needs. Citizens and local leaders have told us that they do not want to impede navigation or use structural options that would significantly alter or affect drainage patterns in residential, commercial, or industrial areas. We will continue to work with this community to identify the flood risk reduction measures that best address Lake Charles's current and future flooding risks.

Channel Realignment

There is significant uncertainty about how to build a channel realignment project. However, a project that has such large land building benefits warrants further evaluation, and the state is committed to undertaking this process. The 2012 Coastal Master Plan thus includes funding to explore how a channel realignment could be optimally designed, built, and operated.

This work will complement the analysis to be conducted as part of the State-Corps Mississippi River Hydrodynamic and Delta Management Study. The study will develop tools to address the multi-purpose benefits a channel realignment could have, including aid to navigation by reducing dredging requirements when sediment is exported from the river channel. These projects could also benefit flood control by shunting excess water flows into adjacent wetlands, thereby reducing pressure on the levee system.

Our goal is to ensure that enough scientific and engineering design work is completed over the next five years to confidently determine whether it would be appropriate to include a channel realignment in the 2017 master plan. If so, we want the 2017 plan to provide a high level of specificity about how such a project could be moved forward. The state will continue to work with our partner state and federal agencies (including the Corps of Engineers), our Ports and Navigation Focus Group, and other experts in large river management to explore the potential of these projects within the broader framework of other river activities.

In Depth Look:
Developing Protection & Restoration Solutions

Terrebonne Bay Rim Marsh Creation

▲ Marsh nourishment.

Our analysis indicated that marsh creation projects were more difficult to sustain over time in portions of the coast, specifically eastern Terrebonne Parish. This region has experienced some of the greatest regional land loss rates along our coast due to a lack of freshwater and sediment input, as well as high rates of subsidence. In addition, some preliminary analysis through the Coastal Wetlands Planning, Protection and Restoration program indicate that soil conditions will add to the difficulty of constructing and sustaining marsh creation projects. For this reason, the master plan recommends a study of the Terrebonne Bay Rim Marsh Creation project to evaluate engineering constraints and innovative solutions. Our goal is to develop a project design that is constructable and sustainable.

Funding Nonstructural Projects

▲ Elevated house construction in Pontchartrain Park.

Our analysis indicated that a large investment in nonstructural projects across the coast is needed in order to reduce flooding risk for many of our coastal communities. However, our analysis did not determine in detail how a nonstructural program would be implemented. The master plan defines the investment of nonstructural funding for each implementation period, but this funding is not restricted to a particular community or a specific type of nonstructural measure. These details will be addressed as we develop the nonstructural program with the needs of each community in mind.

In the first implementation period, the master plan allocates a total amount of $5.5 billion for the program coast wide. In the second implementation period, the plan allocates $4.8 billion coast wide. All coastal parishes are included in the program. See Appendix F for more information.

The Louisiana Coastal Project Development and Implementation Program


▲ Construction of pipeline for Bayou Dupont.

Whether the challenge is flood risk reduction for St. Charles Parish or creating sustainable marsh in Eastern Terrebonne, certain elements of the master plan need to be further developed to assist areas of the coast with recognized, critical needs. That is why continued investment in cutting edge technology and further refinement of master plan components will be critical to our efforts going forward. To provide a means for spurring this kind of innovation, the Coastal Protection and Restoration Authority will establish a Project Development and Implementation Program. The program will identify or further refine projects that are fully consistent with the master plan's objectives and principles using criteria developed for the program. In doing so, the program will have two aims: find answers to problems that the plan identifies as significant but for which a solution does not as yet exist, and identify more cost effective and sustainable ways to address the coastal crisis.

Changes to the master plan may also be necessary if a major hurricane creates a radical shift in the coastal landscape. Any such projects, whether dictated by technical innovation or natural disaster, will be thoroughly documented and discussed with our CPRA technical team, focus groups, and community partners. A primary criterion for addition to the plan will be the project's close adherence to the guidelines presented in this plan. Appropriate analysis commensurate with that performed for this master plan would be required to ensure that the project ideas are good candidates for further investment. Proposals based on these in depth technical analyses will then be brought to the CPRA. No changes to the master plan will be made or funding spent without CPRA approval, and projects must be included in the annual plan prior to implementation. This program is funded at $1.6 billion over the 50 year life of the master plan so it can effectively design and implement necessary projects. An estimate of program funds necessary for each fiscal year will be included in the CPRA Annual Plan. The program will follow the precedent set by this master plan, identifying the best investments for the coast through good science informed by public input.

Benefits of the Master Plan: Flood Risk Reduction

As the residents of coastal Louisiana know, it is not possible to completely eliminate the risk of flooding in a hurricane prone, low lying region. But this vulnerability to coastal flooding is greatly increased as Louisiana loses more coastal land. Our Future Without Action analysis showed that we could experience estimated annual damages from flooding coast wide totaling $7.7 to $23.4 billion over the next 50 years, depending on future coastal conditions. In the face of these mounting risks, communities need action today to bring the threat of flooding down to more manageable levels.

Expected Annual Damages from Floods At Year 50
Under Different Future Scenarios

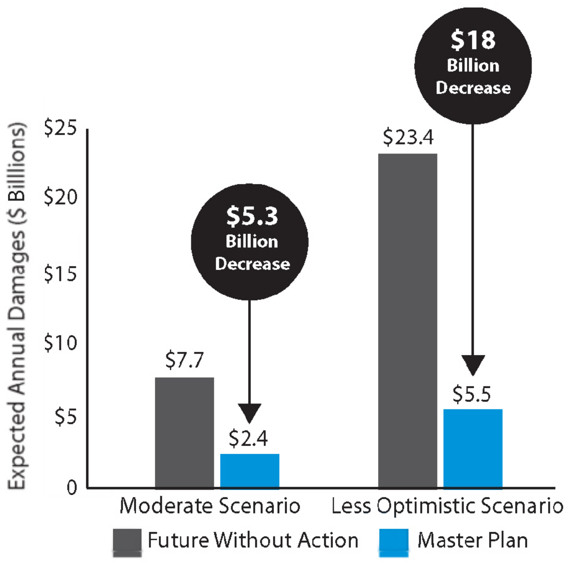


Figure 5.8
Potential change in risk, represented by expected annual damages in the Future Without Action and with the master plan at Year 50.

The plan's investment in increased levels of protection could prevent $100 billion to $220 billion in direct asset damages to individuals, communities, and industry at Year 50. Nonstructural measures are provided for all coastal parishes.

The projects in the master plan can substantially reduce expected annual flood damages. The plan's investment in increased levels of protection could prevent $100 billion to $220 billion in direct asset damages to individuals, communities, and industry by Year 50. This savings figure does not account for reaction and recovery costs, which alone cost over $250 billion for the 2005 hurricanes, not counting the incalculable human costs. These estimates do not account for improvements to the landscape by ongoing restoration measures. Future risk will be reduced even more if we implement the land building projects in the master plan.

The master plan includes projects that will reduce flood damages coast wide by varying levels. Specifically, under the moderate scenario of future coastal conditions, the master plan provides 500 year protection for metropolitan areas, such as New Orleans, Metairie, Kenner and Lake Charles. The plan provides 100 year protection for smaller urban areas, such as Abbeville, Algiers, Arabi, Avondale, Baldwin, Barataria, Bayou Vista, Chalmette, Charenton, Franklin, Houma, Jean Lafitte, Jeanerette, Lafitte, LaPlace, Meraux, Morgan City, Moss Bluff, Patterson, Poydras, Reserve, Sulphur, Violet, Waggaman, and Westlake, through structural protection augmented by nonstructural measures. Risk reduction to rural communities is provided in large part through coast wide nonstructural projects. As discussed previously, nonstructural projects would not eliminate all risk since they depend on voluntary participation. Nonstructural measures are provided for all coastal parishes.

When looking at protection, we had to assess flood risk in a way that was consistent across the coast. To do this, we looked at what is known as "expected annual damages." This concept takes into account uncertainty about when floods will occur. Communities may go years without a serious flood, they may experience minor floods, they may be severely flooded several years in a row—any number of variations is possible.

Our analysis of expected annual damages took a 50 year look at the likelihood of storm surge flooding occurring and determined an average amount of flood damages that every community could expect. This average was expressed as dollars of damage per year. These averages do not imply that every community will flood every year. They are statistical averages at Year 50 of communities' likely flood risk and the damage that would be associated with that risk. Louisiana residents know what the numbers mean: lost jobs, ruined homes, and higher insurance.

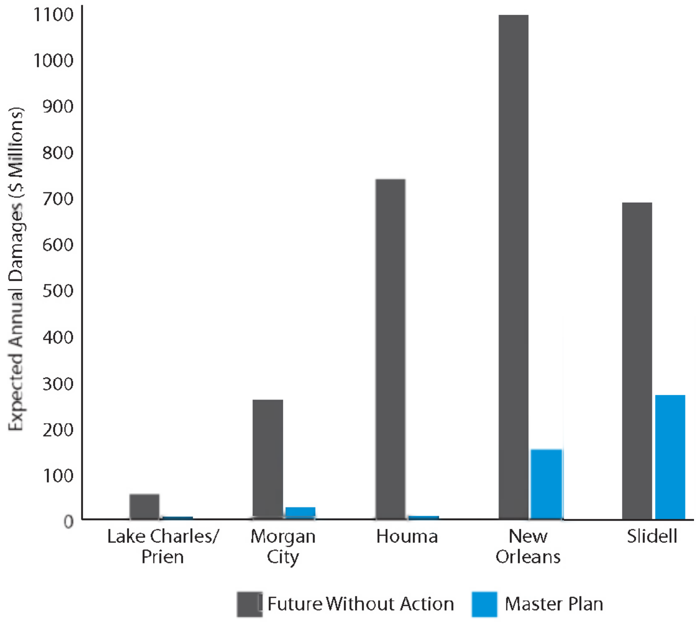
Given the severity of the risks borne by our communities, the master plan aims to achieve a reduction in the frequency and depth of flooding along the coast, even under scenarios of increasing sea level rise and higher storm intensity and frequency. In addition to the overall risk reduction mentioned above, the master plan provides for the following under moderate conditions:

- Nearly eliminates expected annual damages predicted for some communities and parishes in the Future Without Action analysis. A few examples include Abbeville, Chalmette, LaPlace, Lafitte, Iberia Parish, and Vermilion Parish.
- Reduces expected annual damages by more than 75% over Future Without Action in select communities and parishes, such as Houma, Lake Charles, Raceland, Morgan City, New Orleans, and Metairie.
- Reduces by half the expected annual damages predicted in the Future Without Action analysis for the rural areas of numerous parishes, such as Jefferson and Terrebonne.

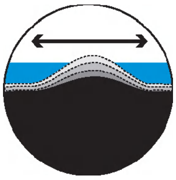
Other communities will still experience some residual risk, partly due to the lack of viable projects to address their risk and partly due to the location of commercial assets that are difficult to protect with nonstructural measures.

Figure 5.9
Average expected annual damages estimated for Future Without Action and future with the master plan at Year 50 for representative coastal communities under the moderate scenario. The Future Without Action analysis includes added risk created in coming decades by growth and increased assets at risk. For details on damages for additional communities, see Appendix D.

Expected Annual Damages from Flooding for Representative Coastal Communities at Year 50



Benefits of the Master Plan: Land Building



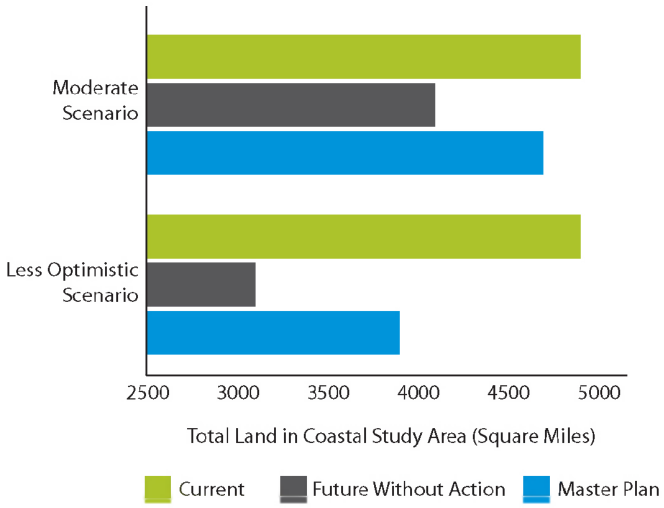
The projects in the master plan have the potential to build between 580 and 800 square miles of land over the next 50 years, depending on future coastal conditions.

Although we are not able to prevent all the predicted land loss with the master plan in the 50 year planning period, the master plan will change the trajectory of land loss, providing a positive net land change into the future. After 2032, the projects in the master plan could achieve no net loss of land under the moderate scenario. After 2042, the trajectory of net land change becomes positive under the moderate scenario, which indicates we are building more land than we are losing.

Under the less optimistic scenario, our net land change remains negative at Year 50. At that time, we predict a land loss rate of 40 square miles in the Future Without Action, which is offset by the 30 square miles of land gained by implementing the master plan. This results in a net land change of approximately 10 square miles lost each year by Year 50. Although we do not achieve net land gain under the less optimistic scenario, taking no action would be devastating to our coastline. Furthermore, since our analysis only extends to 2061, our land building trajectories indicate that some of the projects in the master plan will be building significant land well beyond that date.

Figure 5.10 Current land in the coastal study area, as well as future coastal conditions under moderate and less optimistic scenarios. The green bars depict the current land in the coastal study area and the dark gray bars depict the loss predicted in the future if we take no further action. The blue bars depict the master plan's performance to prevent large scale loss of land in the coastal study area.

Potential Land Area Change Over Next 50 Years Under Different Future Scenarios



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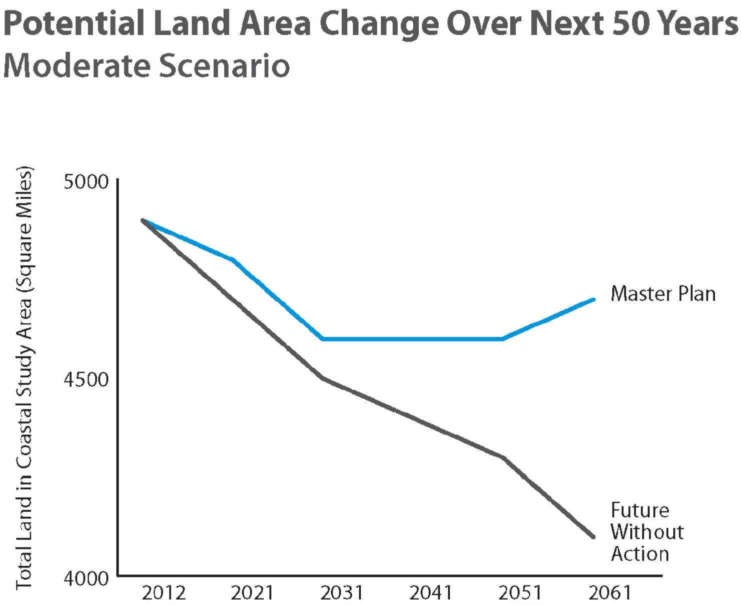
Figures 5.11
Change to the total land in the coastal study area over time for the master plan compared to Future Without Action under the moderate scenario.



Figures 5.12
Change to the total land in the coastal study area over time for the master plan compared to Future Without Action under the less optimistic scenario.

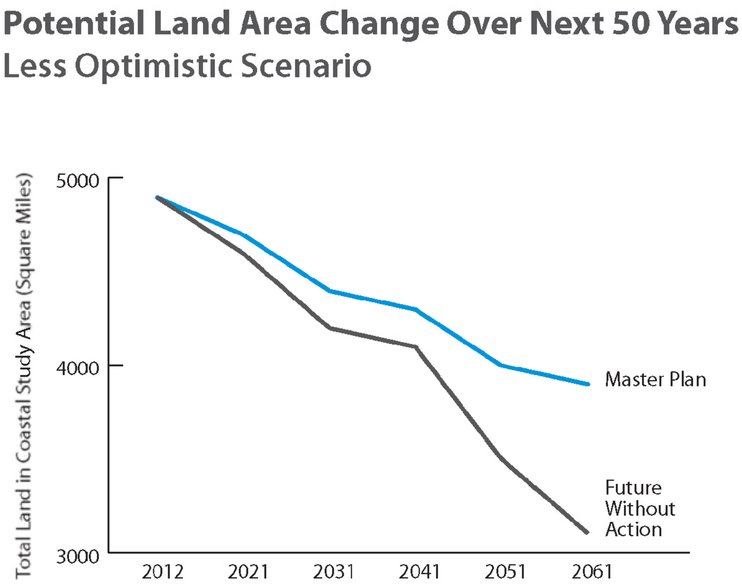


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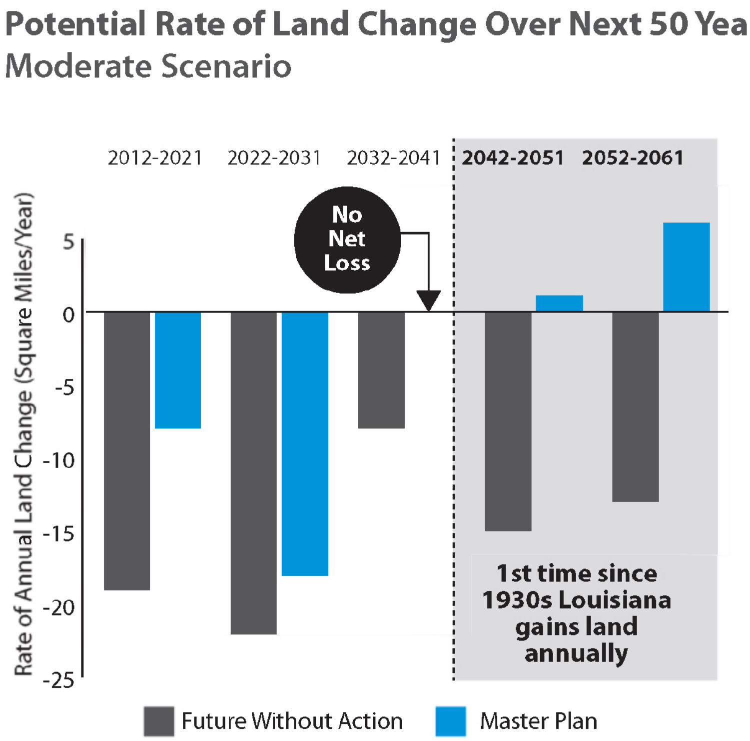
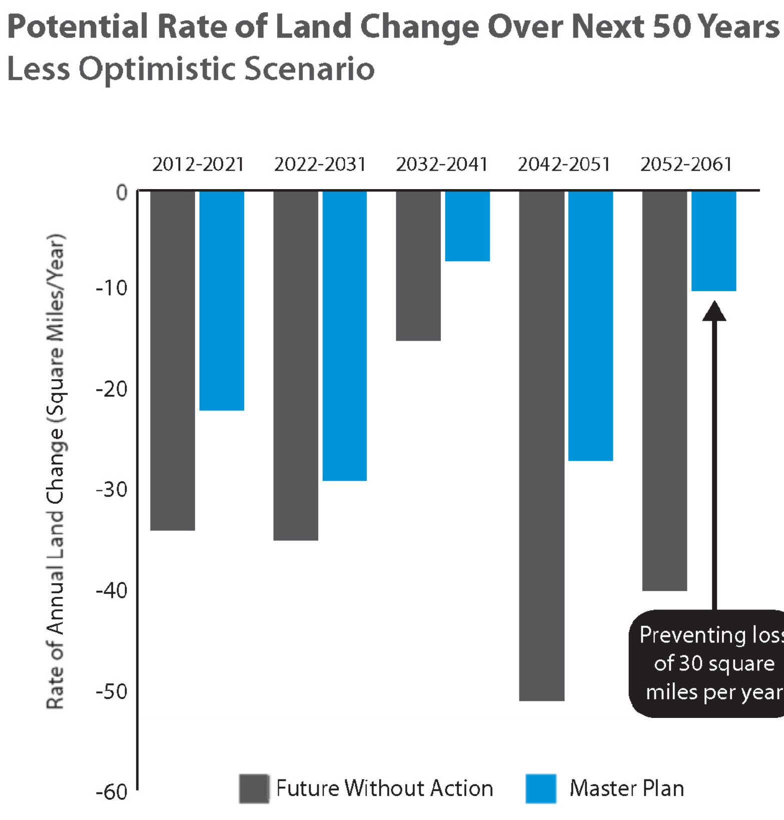
Figure 5.13
Potential changes in the annual rate of land loss or land gain every 10 years based upon the moderate scenario. Implementation of projects in the master plan may result in no net loss after 20 years, and annual net land gain after 30 years.



Another way to look at the master plan's effects on the coastal landscape is to evaluate the predicted average annual rate of change. In the Future Without Action, we continue to lose between 8 to 22 square miles per year. With the implementation of the master plan, we reduce the land loss rate over the Future Without Action. After 30 years, the plan will provide an average annual increase in land area.

Figure 5.14
Potential changes in the annual rate of in land loss every 10 years based under the less optimistic scenario. Average annual rate of land change only reaches net positive numbers under moderate conditions. Although we experience a net land loss, the offset to that loss is significant.



Use of Sediment

As stated in our master plan principles, we will strive to use sediment from outside the system for marsh creation projects so that we do not aggravate the coast's sediment deficit. In some cases, using in system borrow makes sense, but only if doing so would not accelerate land loss or increase wave action. We analyzed projects that use in system borrow, and a limited number of these projects are included in the master plan. The North Terrebonne Bay Marsh Creation is one such project. In implementing this or any other large marsh creation project, we will conduct appropriate analyses to ensure that our efforts do not aggravate the problem we are working to solve. We will also request that the limits of using in system borrow be one of the first areas that the Water Institute of the Gulf investigates (see page 161).

In Depth Look: Reconnecting the River

In order to secure the future of south Louisiana, we need to build land that will last. Our project modeling evaluated the entire Lower Mississippi River, from the Old River Control Structure to the Head of Passes, to see how this land building could best be achieved. We found that sediment diversions and channel realignments have the greatest land building potential of all the individual restoration projects we considered. These projects reconnect the river to its estuaries, and build land that stands the test of time. Because they are so effective, it is no longer a question of whether we will do large scale diversions but how we will do them.

Our analysis indicates that multiple sediment diversions operating at a maximum flow of 250,000 cubic feet per second (cfs) are the key to long term land building, especially in the face of higher sea level and subsidence. Because these diversions are the only way for us to create a sustainable coast, the master plan recommends two 250,000 cfs Mississippi River sediment diversions and funding for multiple smaller river diversions, including two diversions off the Atchafalaya River. These diversions, when operated at their maximum capacities during times of high river flow would use up to 50% of the Mississippi River's water. We will not run these diversions at their full capacities all of the time, but will bring their operation in line with seasonal flooding and high water events. This will allow us to maximize land building and reduce pressure on Mississippi and Atchafalaya River levees. The plan also sets funds aside for detailed review of the Mississippi River channel realignment concept, since this project showed great promise for building coastal land.

We must reintroduce this water and sediment carefully. From ports, to fisheries, to towns and cities, millions of residents and nationally important industries depend on the current configuration of the river. The needs of these groups must be addressed, including their need for a restored landscape. Close communication with communities and other affected interests will be woven into the process as we pursue the design, construction, and operation of these vital projects. For example, the navigation industry needs safe, reliable, unimpeded waterways. The network of ports and waterways in Louisiana's coast is as important to commerce as the interstate highway system, and the state and the nation need them to continue functioning as highly efficient trade arteries.

Sediment diversions can help not only support this functioning but enhance the competitiveness of the navigation industry in Louisiana. The dredging of sediment to maintain waterways requires hundreds of millions of dollars each year. In addition, future environmental conditions threaten the sustainability of the Lower Mississippi River navigation channel. Properly situated and operated diversions could both reduce

Sediment Diversions in the Master Plan

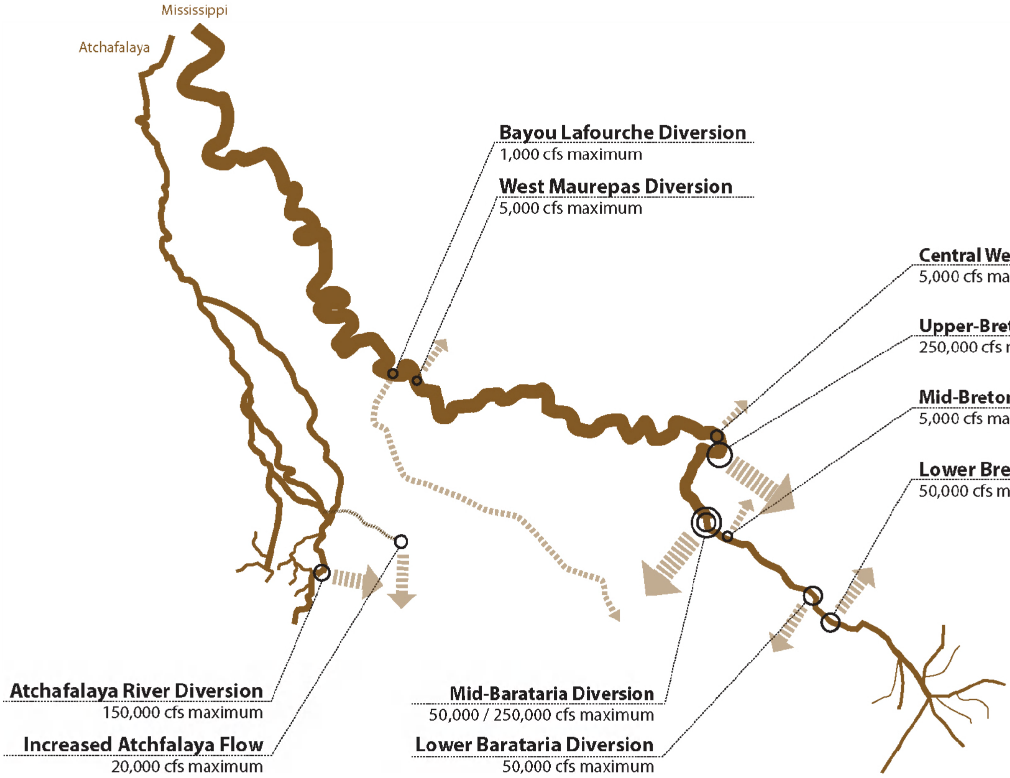


Figure 5.15
Sediment diversions depicted in the map above would be operated in coordination with high river events and seasonal flows. Operation at maximum capacity would occur only at targeted intervals for a fraction of time each year.

dredging costs by removing sediment from the channel and build up the wetlands that protect navigation routes from storm surge damages. As we learn more about how to design and build sediment diversions through master plan funded activities and the Mississippi River Hydrodynamic and Delta Management Study (see Chapter 6), we can identify how best to customize our use of restoration options.

Benefits of the Master Plan: Additional Decision Criteria

In addition to the risk reduction and land building benefits of the master plan, we can gain insight into the effects the plan will have on other important components of the coast, such as cultural heritage. These potential outcomes are described below. Appendix B provides more information about these criteria.

Support for Cultural Heritage

The master plan supports the ability of coastal residents to use important natural resources for their livelihoods, such as fisheries, and live in their traditional communities without the risk of catastrophic flooding. This decision criterion evaluated the availability of fish, shrimp, and oysters to communities as well as opportunities for agriculture, including rice, sugarcane, and cattle farming. By increasing the support for cultural heritage, the master plan will reduce impacts to traditional communities compared to what they would experience under Future Without Action.

Distribution of Risk Across All Socio-Economic Groups

This decision criterion took into account reduction of flooding risk in areas of the coast with low-income citizens. The intent of this criterion was to make sure that the master plan did not increase flooding risks for one group of citizens, and instead, distributed risk reduction across income levels. Our analysis showed that expected annual damages from flooding for low income areas throughout the coast would be reduced by approximately $75 million with the master plan in place. The analysis further showed that we were not disproportionately increasing flood risk for low income communities coast wide as a result of our risk reduction measures.

Flood Protection of Historic Properties

This decision criterion was designed to assess flooding risks to the over 5,000 historic properties throughout the coast. Historic properties consist of historic standing structures, historic districts, historic landmarks, and archaeological sites. Projects that reduce historic properties' flooding risk performed better according to this criterion. As we analyzed project results, we learned that if we take no further action to protect or restore the coast, 1,775 properties would flood during a 50 year storm. The master plan could reduce the number of flooded properties by 506 or about 29%.

Flood Protection of Strategic Assets

Strategic assets, such as ports, refineries, and airports, are important economic assets, and we evaluated 179 strategic assets in the master plan analysis. The analysis indicated that 94 of these facilities would be flooded under Future Without Action conditions. With the master plan, we could reduce the number of strategic assets flooded to 69. Many of these assets are located in highly vulnerable areas based on the location of resources, so complete protection of all strategic assets is not feasible.

Support of Navigation

Maintaining the international competitiveness of the port and navigation industry is vital for the economic vitality of the state and the nation. We accounted for navigation concerns when we sited sediment diversions from the Mississippi River and reduced the number of constrictions, such as locks, in other federally authorized channels. The master plan also supports navigation by including marsh creation, bank stabilization, and shoreline protection projects that restore coastal habitats in the vicinity of federally authorized channels. These projects will help sustain channels, particularly in vulnerable areas that are currently predicted to merge with the Gulf of Mexico. As specific projects, such as sediment diversions and floodgates, move toward implementation navigation interests will be full participants in the planning, engineering and design phases.

Support for Oil & Gas

This decision criterion took into account the many coastal Louisiana communities whose citizens work predominantly in the oil and gas industry. The master plan supports this criterion by providing additional flood risk reduction to key oil and gas communities, as well as building and sustaining land, which will serve to protect valuable oil and gas infrastructure.

Sustainability

The master plan incorporates projects that provide long term land building benefits, meaning benefits that will not require large reinvestments of dollars to sustain or rebuild in the future. This decision criterion was only evaluated for restoration projects, although sustainability of risk reduction projects is equally important and has been incorporated into the project design. Not all projects in the master plan are sustainable over 50 years (e.g., Terrebonne Parish marsh creation). However, the Coastal Protection and Restoration Authority will work on innovative project design to increase sustainability over time.

Use of Natural Processes

Our current coastal crisis is due in large part to past decisions that have altered the natural processes of the coast. Both protection and restoration projects can support or impede these processes. In order to restore these processes and maintain those we have, the master plan includes a wide array of restoration tools focused on using river resources and restoring the coast as a system of barrier islands, wetlands, ridges, and swamps. The master plan also minimizes cross-basin levee alignments that would block natural exchanges. Projects in the master plan that may negatively impact natural processes, such as Morganza to the Gulf, will be designed to minimize those impacts as much as possible.

Project Operations & Maintenance Costs over 50 Years

The master plan should not confine the coastal program to long term, costly operations and maintenance programs that are a burden to taxpayers. Operations and maintenance costs in the master plan represent 7% of the total program budget. General operations and maintenance expenses for levee construction will be the responsibility of the local sponsor.

Benefits of the Master Plan: Ecosystem Services

Ecosystem services are benefits provided by nature. Our analysis of ecosystem services focused on proxy characteristics of the coast, such as provision of habitat (i.e. habitat suitability indices) and other factors that can support these services (see Appendix B). Our ecosystem service evaluation only partially describes our complex coastal ecosystem. We did not, for example, account for harvest or predation. However, we were able to arrive at the following conclusions:

- The master plan does not cause drastic changes to species specific habitats coast wide. Although the location of these services along the coast may shift, overall, the restored coastal landscape will still provide a substantial level of habitats to support a wide array of coastal activities.
- The master plan and our projected Future Without Action both cause an array of complex increases and decreases in ecosystem services associated with vegetation type, percent of open water, edge habitats, salinity, water levels, location in the system, and numerous other variables. These changes also vary regionally.
- For commercial and recreational species, the plan provides large benefits over the Future Without Action for alligator, freshwater fisheries, and waterfowl. The plan also maintains other coastal wildlife, shrimp, and saltwater fisheries at current levels. The plan causes a slight decrease (10-20%) in suitable habitat for oysters. However, this is likely due to a lack of cultch material in many new areas that otherwise would become suitable for oyster cultivation. Overall, data show an increase in salinity levels in many regions suitable for oyster cultivation.
- The public told us that one of the ecosystem services they cared most about was freshwater availability. The analysis found that the master plan could provide a 40% increase in this service over Future Without Action under both future scenarios.
- The ecosystem services of carbon sequestration and nitrogen uptake were also evaluated because of their potential to provide funding streams in the future. By Year 50, under the moderate scenario, the projects in the master plan could return us to 100% of current carbon sequestration levels and over 100% of the current potential for the coastal landscape to uptake nitrogen.
- Nature based tourism is an important aspect of our coastal economy. For example, Grand Isle was recently named by Yahoo! as one of the nation's top five island destinations. The master plan provides a slight increase in this service over Future Without Action.
- The master plan increases suitable agricultural land throughout the coast under both scenarios compared to Future Without Action.

Other Aspects of the Plan

Phasing

The 2012 Coastal Master Plan presents a mix of risk reduction and restoration projects spread across the entire Louisiana coast. We understand that the sooner we are able to implement the projects in the plan the better off we'll be. We will begin work on targeted projects in the first implementation period, depending on funding received. We hope that we can increase the amount spent in the near term as the program gains momentum and more funding is provided. We will track our progress each year in the Coastal Protection and Restoration Authority Annual Plan, which will identify specific projects, schedules, and funding streams.

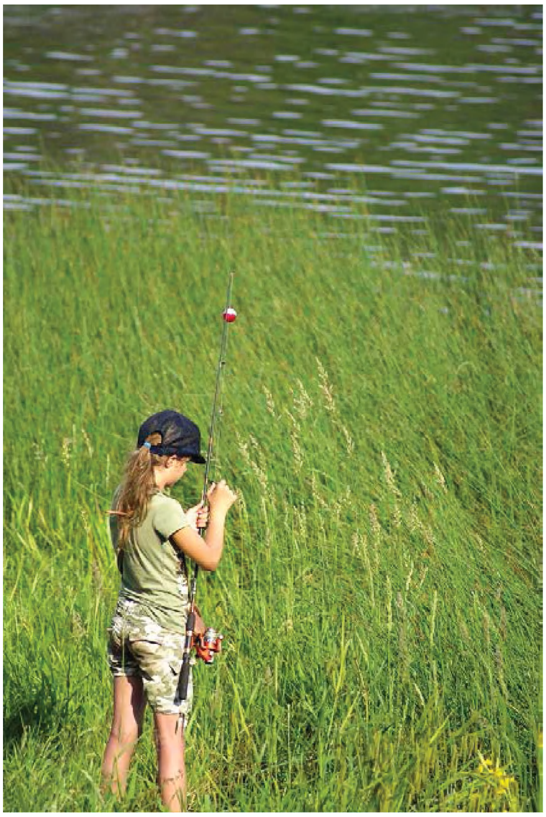
Additional Plan Elements

- We have selected projects that protect the banks of navigation channels as well as shoreline protection projects. Given recent federal appellate court decisions regarding navigation channel maintenance, the Coastal Protection and Restoration Authority has begun an analysis of how these important projects should be funded. This analysis will include recommendations for policy change and estimates of associated costs coast wide. For purposes of this plan, we assumed that funding of these projects would be the responsibility of the federal government. When the CPRA refines its final policy in this matter, we will adjust our project costs accordingly.

- The state views funding for Mississippi River Gulf Outlet Ecosystem Restoration as described in the 2007 Water Resources Development Act as a federal responsibility. The state will work to secure federal funding for projects shown to be important to the overall coastal strategy.

- The state envisions operating the Caernarvon and Davis Pond Diversions, as well as other existing siphons such as Naomi and West Pointe a la Hache in order to maximize the projects' land building benefits. These projects were not included in the master plan because they are already operational; however the state feels these projects are important to our overall restoration strategy.

- The master plan supports two state initiatives that help restore the coast: the Coastal Forest Conservation Initiative and the Conservation and Restoration Partnership Fund. The Coastal Forest Conservation Initiative aims to support habitat by acquiring land rights from willing landowners. The program also funds small scale projects that enhance the forests' sustainability. To date, the program has received $16 million from the Coastal Impact Assistance Program and has been extremely popular with coastal landowners. The Conservation and Restoration Partnership Fund also helps fund smaller-scale initiatives sponsored by local governments, businesses, non-profit organizations, and others. The fund's grants provide matching dollars that allow applicants to leverage larger grant amounts from other sources. Projects funded in this way have included terracing and tree planting projects, as well as other efforts that help restore the coastal ecosystem.



Project Implementation

The state is committed to expediting implementation of the 2012 Coastal Master Plan, beginning with the allocation of funding in the Fiscal Year 2013 Annual Plan and proceeding to preliminary engineering and design of projects as appropriate. Because each project has its own timeline and budget, the implementation process will vary. For example, many projects already have significant engineering and design work completed and can move to construction immediately. Other projects will need to undergo engineering and design. We will carry forward each project based on where it is in the process.

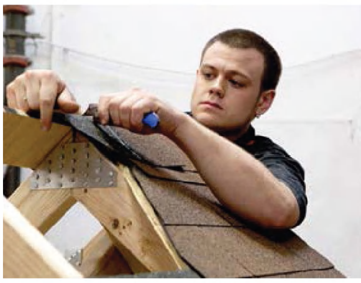
Starting Up Projects

The Project Management Division of the Coastal Protection and Restoration Authority (CPRA) is the state's lead in implementing projects. The staff of this division have expertise in project management and have access to other CPRA professionals in planning, engineering, science, and land rights. Some projects will be implemented by CPRA, while others will be implemented by local or federal partners. Local governments, for instance, have experience in implementing structural and nonstructural projects. Teams will be tailored to the needs of each project.

Each project team will build on the project description found in Appendix A. Teams will be responsible for the following tasks: defining the process to develop the actual footprint and features of each project, beginning the environmental permitting process, identifying real estate needs, assessing local impacts, and beginning the design process. We understand that time is of the essence and that these tasks must be completed efficiently. Each project identified will be appropriately staffed to maintain a streamlined schedule. We will also explore alternative permitting and regulatory approaches to speed up implementation.

The Coastal Protection and Restoration Authority's annual plan will be the vehicle for outlining how projects are implemented. Each annual plan will provide project and funding details for the current year as well as two years in the future. When funding comes in, the annual plan will show how we translate these dollars into project schedules. By providing opportunities for public review and comment, the annual plan will provide an easy way for citizens and legislators to track progress of the 2012 Coastal Master Plan.

Implementing the Nonstructural Program



The Master Plan analysis has confirmed that implementation of comprehensive coast wide nonstructural program can effectively reduce risk. We also recognize that an effective nonstructural program must include both physical and programmatic measures. As implementation begins, more detailed information on flooding characteristics of the project area, the nature of the buildings being protected, and the overall needs of the community must be gathered and evaluated. Our community focus group will be a helpful partner in this effort. Based on this data, a program consisting of both physical and programmatic measures tailored to the community's needs and level of risk can be fully developed and implemented. Appendix F provides more information on the steps we will take toward implementation.

For the 2012 Coastal Master Plan, we evaluated nonstructural projects for each of the coastal parishes and communities. Our analysis identified areas where these measures could be useful and assets for which nonstructural measures would reduce risks. Chapter 2 describes how we structured this analysis. In order to implement the program, we are considering a range of recommendations including those listed below:

- Increase coordination among the many state and parish agencies working on nonstructural issues in Louisiana. As in many states, Louisiana's nonstructural issues are managed by a variety of entities. No other state, however, has a nonstructural program that is as comprehensive or as large as the approach described in the 2012 Coastal Master Plan. In order to effectively implement a nonstructural program of this nature and make this program easy for citizens and communities to use, there should be a single working group or entity to act as a clearinghouse and point of contact.
- Consider supporting local capacity and amending regulatory requirements, as appropriate, to ensure that goals are met in four areas: 1) local land use planning, 2) building codes, 3) flood damage prevention ordinances, and 4) risk reduction project funding.
- Identify the needs of Louisiana residents and encourage the development of those projects, programs, and tools that meet these identified needs and gaps. In some instances, financial support with state funding may be appropriate to address an identified need or support parish level implementation.
- Train those responsible for the program's success and inform the public about the nonstructural options available to them.

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Nonstructural project measures include raising a building's elevation or flood proofing residential and nonresidential structures. We view these measures as key components of protecting communities, knowing that we cannot reduce flood risks purely by building levees. These nonstructural measures can, in some instances, provide results more quickly than can levees. In other cases, using nonstructural and structural approaches together can provide risk reduction most efficiently.

In addition to floodproofing and elevation, voluntary relocation and acquisition measures may be made available to residents as options in areas that will continue to have high flood risk levels even after actions recommended in the master plan are implemented. These options will be voluntary; the master plan makes no recommendations for relocation of specific communities. The plan acknowledges the need to support citizens facing change and to handle disruptions with sensitivity and fairness.

Land Use, Wise Growth, and Other Programmatic Nonstructural Measures

Other nonstructural measures include informing the public about the risk of living in a flood hazard area, enacting local ordinances that require appropriate risk reduction standards, and adopting land use plans that integrate floodplain management concepts. These programmatic measures are particularly important given the need for wise development in Louisiana's coastal zone, and our nonstructural program was developed with the assumption that these kinds of measures are important.

We do not want construction of new hurricane protection systems to encourage unwise development in high risk areas, as has occurred in the past. Such development increases overall levels of risk and diminishes the effectiveness of the protection structures themselves. This phenomenon is called "Induced Risk," and it runs counter to the master plan's objectives of sustaining wetland ecosystems and reducing the flooding risks borne by coastal communities. Similarly, wetland areas inside the hurricane protection system need to remain intact and undeveloped. Land use ordinances that contain nonstructural risk reduction measures along with the use of other nonstructural measures can ensure that our coastal investments bring maximum benefits while providing for economic growth.

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Adaptive Management Framework

Overview

We cannot predict with complete certainty how the Louisiana coast will change under future coastal conditions, with or without additional risk reduction and restoration projects. The dynamic nature of the coast requires that we use an Adaptive Management Framework to implement the projects recommended in the 2012 Coastal Master Plan using procedures or techniques that are flexible, agile, and based on the best available technical, economic and social information. Part of this challenge involves the need to explore new project strategies, including cost effective delivery of sediment using innovative dredging techniques, such as those proposed by Plaquemines Parish. This will allow us to build projects more cheaply and quickly. The Adaptive Management Framework will also identify lessons learned. By doing so, the framework will integrate project design and construction with system level monitoring, which will allow the coastal program to stay abreast of key innovations.

Developing an Adaptive Management Framework

The Coastal Protection and Restoration Authority is committed to developing a programmatic Adaptive Management Framework that will ultimately incorporate all aspects of the coastal program. The overall goal of the Adaptive Management Framework is to ensure that the master plan objectives are achieved by guiding adjustments to planning, policy, and implementation over the next 50 years. The framework will be developed in 2012 and 2013.

To successfully build an Adaptive Management Framework, input is needed from key experts, partners, and constituents. Although an initial framework has been identified, the Coastal Protection and Restoration Authority proposes to continue refining the framework over the upcoming months, building on past adaptive management efforts, and incorporating new aspects of the coastal program to achieve a programmatic Adaptive Management Framework. The Adaptive Management Framework will be facilitated by the annual plan and master plan updates, which are legislatively required every one and five years, respectively. These plans will provide opportunities to report on the progress of the Adaptive Management Framework by assessing overall program effectiveness, reviewing stakeholder engagement, and making necessary adjustments.

Adaptive Planning

Adaptive Planning will be the first phase developed as part of the Adaptive Management Framework. It will focus on evaluating the planning process used to develop the 2012 Coastal Master Plan, incorporating lessons learned, and identifying a strategy for developing the 2017 Coastal Master Plan. Specific actions that will be undertaken as part of this evaluation include, but are not limited to:

- Evaluate acceptance of the 2012 Coastal Master Plan
- Evaluate models, tools, and key uncertainties
- Develop a planning strategy for the 2017 Coastal Master Plan
- Develop a budget and priorities for monitoring, research and development
- Identify a governance structure and key roles and responsibilities

Adaptive Implementation

The second phase of developing the Adaptive Management Framework involves identifying elements that will facilitate program implementation. The goal of the Adaptive Implementation phase is to understand the ability of master plan projects to meet the objectives when implemented in the coastal system. Understanding the complexities of the Louisiana coast requires the work of experts and stakeholders from many disciplines, and it requires that we continually monitor our work. Future studies, like the Mississippi River Hydrodynamic and Delta Management Study, will provide critical information for this effort.

Independent research institutions, such as the Water Institute of the Gulf, in conjunction with other research, academic and engineering institutions will provide a high level of expertise to support quality project performance. The Water Institute's initial efforts will revolve around conducting world-class, independent science to inform and solve coastal problems in Louisiana and the Gulf of Mexico. The institute's long term vision is that the science and solutions that are developed here in Louisiana and on the Gulf Coast will be used to improve water management issues for the benefit of other coastal regions.

Specific tasks included in further development of the Adaptive Management Framework include, but are not limited to:

- Develop a panel of experts to guide the Adaptive Management Framework
- Bolster current monitoring and data collection
- Develop key questions for implementation
- Prioritize and budget research and development
- Develop feedback loops, roles, and responsibilities
- Key Roles and Responsibilities

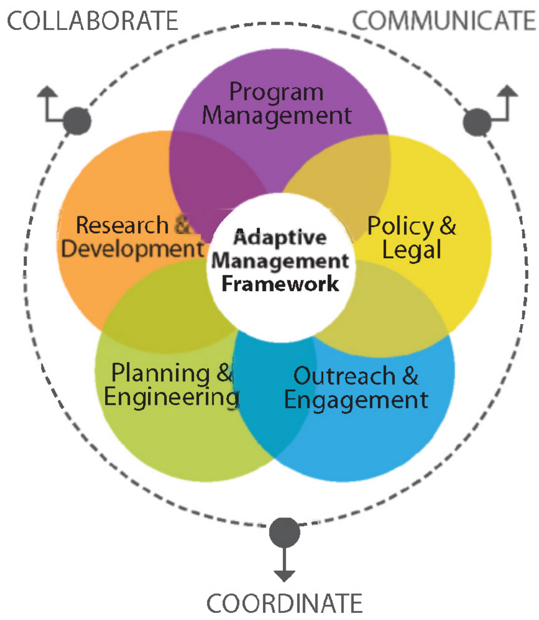

Figure 5.16 The components of the Adaptive Management Framework will build upon the existing structure of CPRA and link all aspects of the coastal program to aid in implementing the 2012 Coastal Master Plan.

Roles and Responsibilities

The complexity and magnitude of master plan implementation requires that state resources be organized and focused. Although developed as a component of the 2012 Coastal Master Plan, the Adaptive Management Framework is intended to identify roles and responsibilities for all aspects of the coastal program. The Adaptive Management Framework will also rely on collaborative partnerships with federal and local agencies, other state agencies, and research institutions to participate as members of the Adaptive Management Framework.

The state will build the Adaptive Management Framework into the current structures of the Coastal Protection and Restoration Authority. The state has identified five key focus areas (program management, planning and engineering, research and development, policy and legal, and outreach and engagement) to maximize collaboration, coordination, and communication. Each of the five focus areas is instrumental to the successful implementation of the master plan, and key feedback loops to the master plan and other coastal program efforts are essential. The Adaptive Management Framework will focus on integrating risk reduction and ecosystem restoration efforts with the institutional knowledge that the program builds over time. This knowledge will support a highly effective program that confronts the unexpected, avoids repeating mistakes, and increases our ability to share our successes with others. Projects, both on the ground and those to be constructed, will be considered.

The Adaptive Management Framework will be a living document that is updated to reflect new understanding and information. The framework should improve implementation of the master plan and continue to move the entire coastal program forward. More detailed information on the Adaptive Management Framework is included in Appendix F.

Chapter 6
Policies & Programs

Elevated residential house being constructed in Gentilly.

Policies & Programs

Chapter Preview

This chapter presents key policies and programs necessary for the successful implementation of the 2012 Coastal Master Plan.

The 2012 Coastal Master Plan presents a mix of protection and restoration projects spread across the entire Louisiana coast. The projects will be implemented based on funding received and associated constraints. Some projects are shovel ready, while others will require the work of experts and stakeholders from many disciplines. Projects and programs that will advance these efforts are discussed below.

Planning and Partnerships

A collaborative planning environment is essential if we are to achieve the objectives of the master plan. We will work with the programs and partners listed below in support of the coastal program.

The 2012 Coastal Master Plan grows out of the state's responsibility to make wise investments for Louisiana's coast based on good science. In addition to guiding state action, the 2012 Coastal Master Plan will also help guide local and federal projects, as well as initiatives undertaken by private and community organizations. We will, therefore, encourage all of these entities to support the plan, with the understanding that leveraging all resources to implement master plan projects is the most efficient way to protect and restore the coast.

At the same time, many good projects that would benefit the coast are not in the master plan because of the projects' smaller scale, a lack of information about the projects, and so on. We recognize that local parish leaders and other groups may wish to use their funds for these or other projects of their own choosing. (e.g., The Plaquemines Parish Plan, the Iberia-Vermilion Parish Plan, and the Terrebonne Parish Plan.) We further recognize the leadership shown by communities such as Terrebonne Parish, which is providing local funds for restoration and protection. We will endorse these projects, recognizing that state support will, in many cases, be essential if local initiatives are to secure federal and other funds. However, if a locally proposed project directly conflicts with the master plan, we will not support the effort. If for example, an entity wanted to impound and isolate an area that was a target for marsh creation in the master plan, we would have to address that conflict. We expect that the strong lines of communication we have with local leaders will reduce the need for such discussions. Understanding the great amount of expertise they can bring to bear, we will continue our longstanding practice of relying on local entities to implement projects when appropriate.

The Louisiana Coastal Area (LCA) Authorizations provided in the 2007 Water Resources Development Act will remain in force; there will be no deauthorizations of LCA projects. The state will, however, focus its resources on LCA projects that show the most benefits, based on our analysis for the master plan. Appropriate modifications to certain LCA projects will also be made so that these projects can be fully consistent with the state's path forward. The feasibility studies conducted by the LCA program will also provide important information for ongoing and future planning efforts.

Our approach is much the same with regard to the Coastal Wetlands Planning, Protection, and Restoration Act Program. CWPPRA has been a mainstay of Louisiana's coastal program for decades and will continue to play a key role in meeting the goals of the master plan. The program will offer cutting edge, field tested information to the broader program, and it will provide an avenue for exploring demonstration projects and other initiatives that support the coast.

CWPPRA has many good projects in the engineering and design phase. However, these projects must all compete for limited construction funding. We will continue to support these CWPPRA projects, focusing our efforts on those that are consistent with the plan's objectives and principles. As the CWPPRA Program seeks to bring new projects into the planning and design phase, we will support doing so only for projects that are consistent with the master plan. Understandably, we will not cost share projects that are in conflict with the master plan. We look forward to working closely with the CWPPRA Program as we take our coastal program to a new level in the coming years.

Landowners as Key Partners

Approximately 80% of the coast is privately owned, and landowners should be partners with the state as projects are planned, designed, constructed, and operated. The rights of these landowners, including mineral rights, must be acknowledged, and landowners must be kept abreast of proposed changes that affect their properties. For example, it will be important to work with landowners to create a checklist of the steps involved in bringing specific master plan projects from concept to reality. To ensure that we engage in constructive communication early and often with landowners, the Coastal Protection and Restoration Authority will create a Landowners Focus Group. This group will meet regularly with the state to discuss projects still in the concept phase, as well as projects that are being designed and constructed.

Landowner assistance will be essential in understanding the complexities of land ownership and stewardship of natural resources. There are many options for navigating these complexities in order to build projects on private land. These measures could range from acquisition and easements, to separating surface rights from mineral rights and allowing the landowner to retain the latter while the state obtains the former. To insure that land rights negotiations are handled appropriately and with the urgency that our state's coastal crisis requires, we fully support future engagement with the Landowners Focus Group on projects that affect privately owned property.

Atchafalaya Basin Program

The basin is the nation's largest river swamp, but it is suffering from an overabundance of sediment. Much of this sediment could be used to help sustain Louisiana's coast, but care must be taken to avoid actions that might damage the basin's ecosystem. Louisiana's Atchafalaya Basin Program provides guidance as to how the health of the basin can be maintained. Close coordination between this program and implementation of the master plan will provide a win-win for both the coast and the Atchafalaya's Basin's critical ecosystem.

Mississippi River Hydrodynamic and Delta Management Study

Since the late 1930s, the Mississippi River has been controlled by federally built levees. By reducing river flood risks and providing reliable navigation, the levees have allowed communities throughout the river's watershed to thrive. But the levees have also deprived Louisiana's wetlands of the sediment and fresh water that once built and sustained them. One of the many severe effects of this land loss disaster has been an increase in hurricane based flooding risk to communities. We must allow more river water and sediment to spread across the delta if we are to provide a sustainable future for the ecosystem, navigation, industry, and communities.

Sponsored by both the U.S. Army Corps of Engineers and the State of Louisiana, the Mississippi River Hydrodynamic and Delta Management Study has begun to lay the groundwork for these changes. A physical model as well as 1-, 2-, and 3-dimensional numeric models will be built as part of this study. Together, these models will help us learn where and how to build the most effective sediment diversions, how to approach constructing a channel realignment, and how not only to build wetlands but also to reduce dredging costs, increase the sustainability of the navigation channel, and increase flood protection for communities threatened by high rivers. The study will also synthesize current science and engineering so that we can better understand the river and its water and sediment resources. In particular, we expect that the study will provide the technical underpinning for implementing large scale sediment diversions and a channel realignment here in Louisiana. We expect the 2017 Coastal Master Plan to contain valuable information from this effort.

U.S. Army Corps of Engineers (Corps) Section 7002 Comprehensive Plan

As part of the Water Resources Development Act of 2007, Congress directed the Corps to prepare a comprehensive plan and to integrate its work with Louisiana's own coastal planning efforts. However, Congress has not yet appropriated funds for the plan, and therefore the Corps has yet to begin work on this task. To prepare the way for the Corps' plan and at the Coastal Protection and Restoration Authority's request, Corps staff worked directly with us as we developed the 2012 Coastal Master Plan. Corps representatives also serve on the master plan's Framework Development Team. We expect to maintain this close working relationship as the 2012 Coastal Master Plan is implemented. The 2012 Coastal Master Plan will guide the Corps as it develops the 7002 Comprehensive Plan, and the state will work with policy makers to support appropriations necessary for the effort. Together, the state's master plan and the Corps's plan will serve as companion documents that guide federal investments.

Addressing Hypoxia

The multi-state Mississippi River watershed is the third largest in the world, and it spans all or parts of 31 states and two Canadian provinces. Louisiana's position at the base of this watershed has created the abundant natural resources found in south Louisiana's delta plain. However, when it reaches Louisiana, the Mississippi River also contains the runoff of 41% of the continental United States. Large amounts of nitrogen and phosphorus, which flow into the river from sources upstream, are channeled directly into the Gulf of Mexico. Once in gulf waters, these nutrients lower oxygen levels. This fosters a hypoxic zone off Louisiana's coast each summer that threatens Louisiana's coastal fisheries and water quality.

State agency staff participated in the writing of the "Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin." This action plan stated that "… at least a 45% reduction in riverine total nitrogen load and in riverine total phosphorus load… may be necessary…" to reverse hypoxia in Louisiana's offshore waters. The Gulf Coast Ecosystem Task Force presented recommendations for reducing hypoxia as well. The nitrogen reductions we need can be achieved through a variety of actions, including improved agricultural management practices, municipal and industrial source reductions, and watershed and wetland restoration. Given the immense size of the Mississippi River watershed, the solution to the hypoxia problem cannot be limited to Louisiana.

Implementing the 2012 Coastal Master Plan will address this problem on several fronts. The master plan recommends multiple sediment diversions that will divert the river's water into sediment and nutrient deprived wetlands. This will put nutrients where they are needed—in the wetlands—and reduce the amount of nutrients directed into the gulf. The state's nitrogen uptake model will also continue to investigate how projects can reduce nutrient levels. The state is establishing a water quality credit program that assesses the effectiveness of wetlands to filter nutrients. The master plan also supports the Louisiana Department of Environmental Quality and the Louisiana Department of Agriculture and Forestry's efforts to implement the state's nutrient reduction strategy under the Gulf Hypoxia Action Plan. The master plan will be a key component of this ongoing strategy.

Effects on Job Creation

▲ Construction on the Lake Pontchartrain and Vicinity Hurricane Risk Reduction Project.

Land loss and flooding risks are changing the way people live, work, and do business throughout Louisiana's coast. The projects in the 2012 Coastal Master Plan are intended to prevent the economic and environmental collapse that will occur if land loss continues. These projects will also bring change, and many social scientists are exploring what these changes will mean. Some shifts will be challenging in the short term, as when projects alter locations of some fisheries. Other changes may bring unexpected economic benefits. Several recent studies have examined how coastal restoration measures will help Louisiana's working coast.

A common theme in these studies is how readily coastal restoration and protection efforts create jobs. A recent LSU/Louisiana Workforce Commission study found that the $618 million spent by the state in 2010 on coastal restoration created 4,880 direct jobs and an additional 4,020 indirect and induced jobs, for a total impact of 8,900 Louisiana jobs. The spinoff benefits of these jobs were considerable; the study estimated that the state's initial investment in 2010 created more than $1.1 billion in sales. Louisiana's annual investment in coastal restoration alone is expected to be between $400 million to $1 billion, which would translate into 5,500 and 10,300 total jobs, $270-$520 million in wages, and between $720 million and $1.35 billion in total sales per year.

Another study by Duke University found that Louisiana is already a national leader in the creation of coastal restoration jobs, with the highest concentration of related business headquarters in the Gulf. According to this study, restoration jobs spur investments and jobs in a range of sectors including shipbuilding, equipment repair, and manufacturing. The Duke study emphasized that to expand this job creation engine, Louisiana would need to maintain a steady investment in restoration efforts so that relevant firms will have an incentive to scale up their investments.

Operation of dredging equipment for Goose Point marsh creation project.

A third study by Restore America's Estuaries, which looked at restoration efforts nation wide, found that restoring our coasts can create more than 30 jobs for each million dollars invested. This is more than twice as many jobs per million dollar invested as is gained by the oil and gas and road construction industries combined. Further, the study found that investing in restoration provides long lasting benefits to local economies, such as higher property values, better water quality, sustainable fisheries, and increases in tourism dollars. For example, waterfowl hunting contributes $62 million to the Louisiana economy and supports more than 1 million jobs. Wildlife watching contributes more than $300 million to the state's economy each year. Restoration activities that improve habitat for wildlife not only help sustain our coast, they keep our state's economy strong.

Many have cited the need to ensure that protection and restoration dollars spent by Louisiana provide jobs for local residents. The studies cited above affirm that, in general, state investments in restoration stay local, meaning that they create jobs and spinoff effects in the state. Helping local workers train and successfully compete for these jobs is important, and numerous state and local agencies are working now to help residents who wish to prepare for new careers in this arena. While the master plan is focused on providing the basis for protection and restoration of our coast, we support these efforts to foster our state's employment capacity and look forward to contributing to the growth of Louisiana's future economy.

In addition, the state is exploring how coastal protection and restoration efforts will affect local communities. For example, we are working with the University of New Orleans to gain a more precise idea of how changes in resources are affecting fishers. Those administering the study are compiling oral histories and using site visits to ensure that their findings reflect the realities citizens face. The results of studies like these will inform the coastal program going forward.

Transition Assistance

This plan supports the long term sustainability of south Louisiana so that our citizens can have more certainty about the future. The action we need requires changing the landscape, not just tweaking what we already have. As our Future Without Action analysis showed, the landscape and conditions we have now are not sustainable. In fact, as coastal residents well know, change is happening already. If we don't take large scale action, land loss and flooding will grow so severe that ours will be the last generation that benefits from Louisiana's working coast. We should also keep in mind that while some view large coastal restoration projects as having short term detrimental impacts, these projects also have positive and significant long term economic and ecosystem effects. By bolstering wetlands over time, these projects can support activities, such as fishing, that require healthy coastal habitats.

In some cases change creates dislocations small and large. Some of these dislocations are happening now as a result of our land loss crisis. We take these dislocations seriously and understand they represent real costs for real people.

Understanding that large scale projects may often be accompanied by long implementation timeframes, we will use the extended start up time for these projects to help communities and user groups in the following ways:

- Develop a planning framework to help communities, businesses and individuals adapt to anticipated changes in the landscape.
- Work with affected communities and stakeholders to design projects that consider ways to minimize unavoidable impacts while still meeting project, and master plan objectives necessary to avoid the loss of the entire coastal system.
- Identify public and private tools that may assist communities, businesses, and individuals in the transition process. These could include such things as helping specific industries with changes in equipment needs (e.g. docks, ice houses) and finding ways to help small businesses handle cost increases associated with changes in the landscape.

Policy and Legal

Given the emergency facing coastal Louisiana, it is imperative that all government agencies, from federal to local, act quickly and in accord with the master plan. Revisions to some laws and regulations may be needed to help the state's coastal program achieve its goals.

Gulf Coast Ecosystem Restoration Task Force

The Gulf Coast Ecosystem Restoration Task Force was created by President Obama on October 5, 2010 to spur the gulf region's long term recovery following the Deepwater Horizon Oil Spill. The task force issued a final report in early December 2011 that endorses the overall approach of Louisiana's 2012 Coastal Master Plan and seeks ways to support our state's efforts.

Deepwater Horizon Oil Spill

The effects of the Deepwater Horizon spill continue to be felt in Louisiana and will affect coastal planning. The traditional Natural Resource Damage Assessment (NRDA) process usually takes many years and is strictly governed by a team of state and federal agencies, called the trustees. Ideally, project concepts identified as critical by the master plan process will inform the trustees as they design projects to repair injuries caused by the spill. Louisiana may receive other sources of compensation, whether from fines assessed under the Clean Water Act or from payments issued by British Petroleum or other responsible parties to state agencies for costs incurred as a result of the spill. It is too early to tell how much of either source of funds will be directed to coastal protection or restoration projects.

In the coming year, five affected Gulf states and two federal agencies (National Oceanic and Atmospheric Administration and Department of Interior) will share a $1 billion "down payment" to restore areas of the coast damaged by the Deepwater Horizon oil spill. Louisiana will receive $100 million of these funds outright, and we expect that another $300 to $400 million will be used to implement projects in Louisiana. This money will be used to build projects for the coast, using the master plan as guidance.

The master plan will guide how funds from NRDA and other sources are used. Once the funds come in, we will determine which of our master plan projects most readily conform to the mandates of the funding source, and then fast track those projects for implementation.

Beneficial Use of Dredged Material

A great deal of sediment is dredged in south Louisiana, and much of it could be used to rebuild marshes. However, this sediment is usually pumped in upland disposal sites or dumped in the Gulf of Mexico. Beneficially using this dredged material to rebuild wetlands is a strategy whose widespread adoption is long overdue. In recognition of this fact, since 2009 the state has required private applicants who want to dredge more than 25,000 cubic yards of sediment to place the dredged material in a coastal restoration project or pay a fee.

However, the state's new regulations do not affect the Corps of Engineers when it dredges sediment in the coastal zone. Because it maintains national navigation channels, particularly along the Mississippi River, the Corps dredges more sediment than any other entity in Louisiana: 58 million cubic yards a year. Very little of this material is used to create new wetlands. The Corps contends that current authorizations and budgets do not allow them to undertake widespread beneficial use of dredged material. Funds from the federal Harbor Maintenance Trust Fund could be used to supplement the Corps budget for this purpose, and the state recommends that this and other options be fully explored.

Bringing in sediment from outside the system, by mining sediment from major rivers and navigation channels, is a fundamental principle of this plan. As the state implements the large scale marsh creation projects laid out in the master plan, it is imperative that we use the sediment from Corps dredging activities.

Mitigation Policy

Many coastal communities are facing the reality of "restore or retreat." As a result, mitigation for wetland impacts as a result of development or other actions in sensitive coastal areas must meet not only the letter but the spirit of the law. The state's mitigation program must contribute to the comprehensive sustainability of the coastal wetlands and communities, rather than simply compensating for short-term impacts to wetlands. Clearly defined goals for a compensatory mitigation program must align with and complement the master plan.

Some of the recommendations that have evolved to handle this issue include:

- Developing new mitigation regulations that select the most effective and equitable means to accomplish mitigation goals.
- Working with the appropriate federal agencies and the mitigation banking community to locate banks that are consistent with the objectives of the master plan. Mitigation banks could be given additional habitat credits for locations that are consistent with the master plan. The mitigation bank maintenance obligation could be reduced accordingly.
- Including in Louisiana's Mitigation Program a robust in-lieu fee program as an option. This would offer a flexible alternative for mitigation when responsible development takes place in the coastal zone.
- Ensuring mitigation credits can be applied to restoration projects highlighted in this plan.
- Monitoring the implementation of mitigation to ensure that the program is achieving the desired results. This may require revisions to laws, rules, and procedures.

Congressional and Legislative Actions

The State will identify and monitor Congressional actions needed to streamline and expedite the implementation of the master plan. The state will also identify and monitor actions needed by the Louisiana Legislature to ensure that state regulations and policies are consistent with the master plan. As we implement the 2012 Coastal Master Plan, we must evaluate coastal regulatory programs and policies that could impact land loss rates to ensure that these programs support the objectives of the master plan. Sound resource management practices and policies must be implemented at the state and local levels so that coastal resources are used in ways that support our working coast and our protection and restoration efforts.

Sound Management of Limited Resources in the Coastal Zone

The Louisiana Legislature should consider an updated inland boundary for the coastal zone based on findings and recommendations of the 2010 Coastal Protection and Restoration Authority document: "Defining Coastal Louisiana: A Science-based Evaluation of the Adequacy of the Inland Boundary of the Louisiana Coastal Zone."

Freshwater Management Plan

This plan relies on having enough fresh water and sediment to help rebuild the coast, combat salinity, and enhance habitats. Fresh water is also needed to maintain resources for homes, businesses, large industries such as navigation, and the daily needs of our landscape. Because a reliable supply of fresh water is critically important to Louisiana, a surface and groundwater management plan should be developed to ensure that the state secures the sustainable use of these valuable resources into the future.

Conclusion

Responding to an Emergency

The coastal crisis we are experiencing in south Louisiana means there is no time to waste. People need solutions, and they need them now. Given this urgency, this plan's charge was clear: present specific, achievable actions that will protect households and businesses and reverse our state's catastrophic loss of land. The five master plan objectives set the bar high; the benefits of this plan had to be felt across a wide variety of people, communities, ecosystems, and economic sectors. From communities at risk, to habitats under threat, to business owners who are uncertain about the future, the range of needs in coastal Louisiana is huge, and the plan had to address that complexity.

The master plan cannot do it all; it does not promise to maintain current conditions, much less rebuild the coast of 100 or even 20 years ago. Nor can it endorse every project idea that has popular support. But the plan does something more crucial—it presents a new way to think about protecting and restoring our coast. Previous plans talked about useful strategies, but they did not explore the details of what we could do and what it would cost. Citizens were left wondering what the future would hold, even as gulf waters encroached more on their land every day.

The 2012 Coastal Master Plan provides the information citizens need as they seek to take care of their families, manage businesses, and plan for the future. Since 2007, the state has made unprecedented investments in our coast, and the plan builds on this momentum. The projects outlined in the plan strike a balance between providing immediate relief to hard hit areas and laying the groundwork for the large scale projects that are needed if we are to protect communities and sustain our landscape into the future. This approach reflects the need to build projects now while also investing in more conceptual efforts that must ultimately be part of the solution.

A New Way Forward

This plan is something new for our state. It offers a path forward based on an unbiased examination of the best available scientific information, and it builds on Louisiana's recent success in accelerating the pace of coastal protection and restoration. In addition, the plan is designed to offer something that coastal residents have long been needing: more certainty about what to expect. Our assessments of the Future Without Action, coupled with the estimated future effects of the projects we have selected, offer coastal residents a preview of the improvements to flood protection they can expect and how the coast will change as we continue to bring projects on line.

Many parts of this document describe the technical analysis in depth, and providing this level of detail about engineering and environmental factors was intentional. We wanted readers to be able to follow and have confidence in the rigorous analysis we performed, an analysis that identified a path for creating a sustainable future for south Louisiana. Although our process may seem complicated, our purpose was simple: to protect Louisiana communities so they could rebound quickly from floods and provide an ecosystem that thrives over the long term.

A good plan is a blueprint for effective action, and financial realities are a big part of bringing a plan from concept to reality. For this reason, we considered the financial aspect at every stage of our process. Every proposed project has an estimated cost. We also identified an overall budget based on what the state can reasonably expect to receive in coming decades and evaluated projects with cost effectiveness in mind. This approach allowed us to describe how we would spend the dollars we have in hand, and how we would use new dollars that are allocated for Louisiana's coast. If new funding becomes available, the plan is designed to be scaled up quickly so that we can take maximum advantage of every opportunity.

Committed to Our Coast

The citizens of Louisiana know that we must speak with one voice about our commitment to the coast. People from all walks of life have rallied around the 2012 Coastal Master Plan, recognizing that we must embrace bold solutions if we are to tackle the crisis that has gripped our coast for so long. These solutions will preserve our nation's energy and economic security, restore the health of the gulf region, and support a bright and safe future for all coastal residents.

We look forward to working with communities, local leaders, and our state and federal partners to implement this plan. Although the work will be challenging, the rewards will be great. Most importantly, our children and grandchildren will thank us for saving the incomparable Louisiana that we are fortunate enough to call home.


CAPT. TOBY

Next Steps

This plan builds on what has come before and sets the path for the future, but it is not the last word. We will continue to upgrade our tools and our understanding of coastal processes and how projects can work most effectively. Louisiana citizens will see this progress reflected in upcoming annual plans and in the next master plan we develop in 2017. We encourage citizens to stay in touch with us as we implement this new path to a sustainable Louisiana and plan for ever greater improvements. We can best tailor our recommendations to the needs of coastal communities if we hear from you.

Check website for updates
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Suggested Citation
Coastal Protection and Restoration Authority of Louisiana. 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. Coastal Protection and Restoration Authority of Louisiana. Baton Rouge, LA.

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Table of Contents

Introduction

Chapter 1

Chapter 2

Photo Credits (cont.)

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